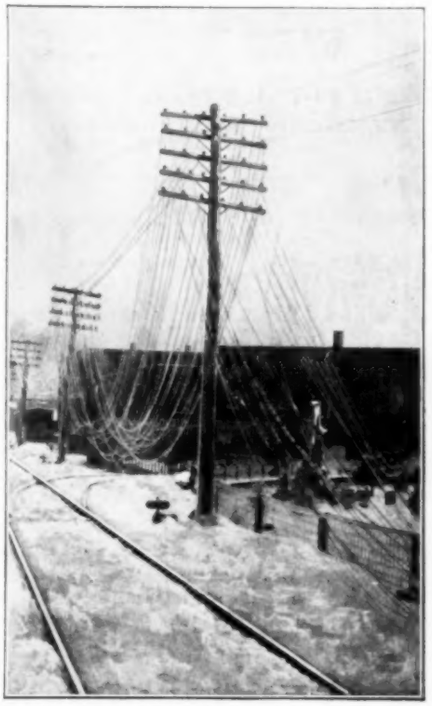
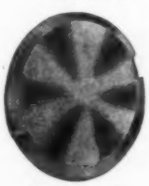
TELEPHONE ENGINEER

Vol. IV CHICAGO, JULY, 1910 No. 1

Guess Which
is the
Copper-Clad
Steel Wire
?



Weld-Clad



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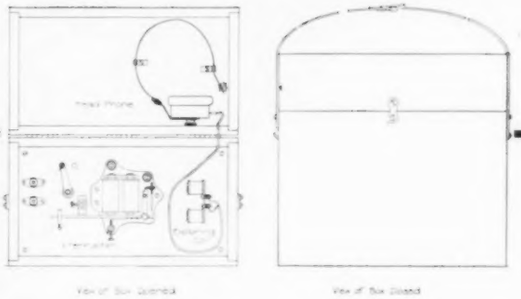

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TELEPHONE ENGINEER

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INTERSTATE COMMISSION REGULATION.

THERE has been some criticism of the clause in the railroad bill putting telephone and telegraph companies under control of the Interstate Commerce Commission, on the ground that the enactment of the clause puts too heavy a burden upon the commission. This seems to be the only argument against the act; and it is unnecessary to point out its weakness. Interstate telephone traffic has within the last few years attained such proportions that its regulation has become a necessity and the functions of the commission must be expanded to include such regulation, even if that body must be increased to meet the added duties imposed upon it.

Section 7 of the present act, amending Section 1 of the Act to Regulate Commerce of 1887, confers upon the commission the following powers:

> All charges made for any service rendered or to be rendered in the transportation of passengers or property and for the transmission of messages by telegraph, telephone, or cable, as aforesaid, or in connection therewith, shall be just and reasonable; and every unjust and unreasonable charge for such service or any part thereof is prohibited and declared to be unlawful; provided that messages by telegraph, telephone, or cable, subject to the provisions of this act, may be classified into day, night, repeated, unrepeated letter, commercial, press, government, and such other classes as are just and reasonable, and different rates may be charged for the different classes of messages; and provided further, that nothing in this act shall be construed to prevent telephone, telegraph, and cable companies from entering into contracts with common carriers for the exchange of services.

It will be noted that nothing is said in this paragraph, nor is there anything in succeeding sections of the act, restricting free service over interstate lines, although parallel provisions are in force in railroad regulation. In an amendment to Section 15 of the act the commission is given power to regulate joint rates, where such joint rates do not apply wholly within one state.

The act placing telephone and telegraph companies under the jurisdiction of the Interstate Commerce Commission is largely an independent measure, since resolutions endorsing such control have been passed by a number of state independent associations at recent conventions, and the officers of the National Independent Telephone Association have taken an active hand in advocating such legislation and in pointing out the probable pitfalls and loopholes which must be avoided in drawing up the act.

In all the discussion which the new act has given rise to, however, little has been said about the ultimate interconnection of Bell and independent lines—a result which is inevitable in any case, and which will be hastened by commission control, just as the interchange of railroad business was fostered by the same body. This is a matter upon which the independents are more or less divided; some of the "old school" still believing that Bell and independent lines should be kept wholly separate, while the more progressive element advocate interconnection

as the only solution of many problems of service. Willis J. Abbott, in a special dispatch, dated June 22, says:

> Nor is there any reason why the independent telephone companies, which have sprung up in such numbers in Michigan, Ohio, Indiana and Illinois, shall not have exactly the same right to switch their messages on to the Bell wires that a little railroad has to shunt its cars on to the Pennsylvania track if its freight is billed that way.
>
> There seems to be no reason why the message sent over the independent telephone line shall not have exactly the same right to be carried over the lines of the telephone monopoly as a letter has to be carried over the lines of any railroad. That is going to be one of the fights for the better service of the public that will be fought out within the next year or two.

Mr. Abbott in this communication places the onus of refusal upon Bell shoulders, which supposition is not entirely correct. But there is no question that with national regulation an operating company will have to show a more vital cause than sentiment before it will be supported in its refusal to connect with competing lines.

In October, 1909, TELEPHONE ENGINEER advocated editorially the physical connection of all lines as the only possible method of meeting the demands of telephone users. All telephone authorities are agreed upon this subject, and the only obstacle in the way of its previous accomplishment has been the inability of competing companies to agree upon the terms of interconnection. With this impediment removed by a central controlling body, we may expect soon to see the beginnings of that dream of all good telephone men, universal service.

ENGINEERING IN FRISCO.

THE problems of the new San Francisco automatic installation were perhaps as complex as any that ever exercised the ingenuity of independent engineers. How they were solved is well told in A. B. Smith's paper "Telephone Engineering Problems Around the Golden Gate," which was read before the last convention of the American Institute of Electrical Engineers and is abstracted on another page.

Comment may well be made at this point on the increasing interest in telephone problems displayed by electrical engineers whose own problems are so intricate and engrossing. Those manipulators of high tension and high frequency, of mighty powers and marvelous transformations, have rather been wont to regard lightly the delicate requirements of the speaking current. They are only beginning to realize the immensity of the tiny force that unites the intelligence of remote places.

In serving San Francisco there are many problems beside the ordinary ones which obtain in the operation of any large exchange system. The extraordinarily cosmopolitan nature of the city is a rather peculiar factor in determining the nature of service. The Chinese population, for example, merely incidental in other big cities, forms in San Francisco an important part of the whole, from a business viewpoint. Of course the non-English speaking population of any city is a distinct problem in manual telephone practice; but it might be supposed that with the automatic telephone the problem would be confined wholly to the two subscribers who were momentarily under the necessity of understanding each other. This is not entirely true, however. The Arabic numerals on the dial, of course, are common to practically all nationalities except the Chinese; and for the latter a special dial has been provided. The Chinese use the telephone quite largely between themselves, and this traffic is sufficiently voluminous to be of considerable importance to the company. They use it comparatively little for communication with those of other nationalities, so that the Chinatown traffic is almost isolated. The same is, of course, true in a less degree of other foreign settlements.

The San Francisco earthquake and subsequent fire in 1906 introduced the greatest problems of all. Previous to that time there was no regular automatic exchange in the city, although a small exhibit of the system, which was destroyed in the big disaster, had excited considerable interest. But the peculiarity of the new problem lay in the fact that the rebuilt city did not follow the lines of the old one. An opportunity was presented in the effacing of the old district boundaries to reconstruct according to modern theories and to profit by previous mistakes. It was to these new ideas that the telephone systems had to conform, making development studies on a basis of forced rather than natural growth.

The special circuits and apparatus to meet special conditions, as described by Mr. Smith, are extremely interesting and reflect great credit on the engineers of the Automatic Electric Company, who designed them. While every big installation makes exacting demands upon the manufacturing engineers, the requirements of San Francisco were unusually particular. Fortunately, every special condition successfully met means not merely local satisfaction, but a distinct step forward in the art. The problems solved at San Francisco will help the next installation and add to the ultimate prosperity of all automatic systems.

But in giving credit to the manufacturing engineers it should not be overlooked that the operating engineers are largely responsible for the success of the San Francisco system, and for many of the innovations which helped to make that success. To the untiring effort and conspicuous ingenuity of the engineers of the Home Telephone Company of San Francisco is due the greatest praise for the perfection of one of the most important installations of independent history.

NEBRASKA'S SUCCESSFUL SYSTEM.

THE Independent Telephone System of Nebraska is meeting with a success that must rest largely upon its simple and understandable constitution and by-laws. To be a member of the Nebraska system you must operate an independent plant. You must weave your system into others of like kind. You must buy one share of the stock of the Nebraska system for each five hundred telephone units or fraction thereof that you operate and you must pay ten cents per unit per annum as an assessment. The unit consists of a telephone or a circuit mile of toll line. You must agree to do these things for a period of twenty-five years.

The first requisite is fundamental. The Nebraska system is non-Bell. There is no way to get into the system if you have Bell connections and there is no possible way to make Bell connections and remain in the organization. It seems to offer a practical solution of the problem that has confronted independent telephony. It binds several exchanges into a concrete, harmonious working organization and there is promise that the idea will grow.

But it also means that every member must maintain a high order of efficiency in his plant and provide means of interchanging telephone traffic. This traffic is adjusted through the clearing house which is not a part of the Nebraska system, although the mem-

bership of one is identical with the membership of the other.

This scheme is the first sensible and economic plan that has ever been accepted by independent operators. It is infectious and when fairly under way it will offer genuine competition, bearing the brand of the shield.

END OF THE HULFISH SERIES.

WITH the installment in this number of TELEPHONE ENGINEER, "Lesson XVIII," the series entitled "How to Read Telephone Circuit Diagrams," by David S. Hulfish, comes to its close. Many of our readers, as they see the words, "The End," will feel that they are bidding farewell to an old friend. The Hulfish series has been a feature of this paper since its inception a year and a half ago. It was written to aid the practical man in the analysis of telephone connections whose complexity is constantly increasing with the evolution of the art. How well it has succeeded in its purpose hundreds of commendations bear testimony. There has been little literature of this nature in the telephone field heretofore; none that supplied the reader of circuits with the actual tools of his trade.

Those who have followed the series, therefore, will be glad to know that it will be issued shortly in book form. As a reference volume it will find a place not only in every telephone library, but among the tools and blue prints of every worker in the field.

Our readers will doubtless agree with us that for lucidity of style and accuracy of statement Mr. Hulfish is unexcelled among contributors to technical literature. Therefore it gives us pleasure to announce another series from his pen, to begin publication in the course of a few months. The new series will be entitled "Automatic Telephony," and will treat thoroughly the intricate subject indicated by its name. There is probably no more complex subject in technics than automatic telephony; but Mr. Hulfish is an authority in this new field, and his remarkable ability to communicate to others his knowledge of any subject is assurance that the new series will be valuable. Further announcement will be made before publication of the series is commenced.

APPRAISALS OF TELEPHONE PROPERTIES.

SUPERVISION by state or municipal authorities of rates charged by operating telephone companies and other public service utilities is fast becoming the rule rather than the exception. The judicious exercise of this function by commissions or other public bodies works no hardship on the company whose rates are being adjudicated, provided a true and proper basis be found from which to figure the value of service, and an equitable return on investment be allowed.

Equitable return on investment is a comparatively simple matter—in spite of the attempt on the part of Chicago officials to reduce the dividend-earning power of the Chicago Telephone Company from eight to six per cent. Careful consideration of the nature of the company's franchise—limited-term, long-term or perpetual, exclusive or non-exclusive—will indicate the value of that company's securities as an investment and the return which will consequently be equitable. Six per cent is ample return to investors in a company operating under an exclusive perpetual or long-term franchise. Eight per cent is none too much in the opposite case.

The matter of return to investors, however, is but one factor in determining the cost of service. The value of the plant, where it may not be determined satisfactorily from the books of the company, must be decided by a physical inventory of the property. Finding the cost of duplication involves no special difficulty for the engineer, and in fact does not even call for a particularly high grade of engineering talent. The proper amount to charge off for depreciation, however, is rather a more complex problem, since even at the present day authorities disagree on the subject. In fact, depreciation and its allied causes form far too complicated a subject for extended discussion at this writing.

But disregarding the finer points involved in the calculation of depreciation, it is a simple matter to make allowances which will approximately correct the dwindling value of depreciating property so that the future of the plant is reasonably provided for.

The franchise and "going value" of the company constitute its intangible values. Future net earnings for the unexpired period of the franchise form a basis for calculating the present franchise value. Practically no franchise value exists where the property is subject to purchase by the city at its expiration.

The Wisconsin State Railway Commission has held that money reasonably and judiciously expended in developing or establishing the business of an operating company may be included in the calculation of value for rate-fixing. The losses encountered in the first years of business, for example, may be considered in the light of necessary expenses in establishing such business. Conversely, past earnings covering more than a reasonable return on investment may be applied against present value. And since the basis for present rate making is present value, or present cost of duplication less depreciation, so it is the present value of the franchise, and not its original cost, that should enter into the calculation. The commission says:

> The element of "going value" created by the investments made in developing the business and in addition to the cost of the physical structure must be taken into consideration in fixing value; although the franchise of a public utility operating under an indeterminate permit has expired upon the exercise by the municipality of its option to purchase, the plant is to be taken over as a going concern, and just compensation must be awarded for the property taken as a living and operating entity, engaged in serving the public, and not as a mere plant without patrons and without privilege or right to operate and to serve the public and having but a salvage value.

It is obvious that if a telephone system be provided ready to deliver service, and have no subscribers, the expenditure necessary to secure subscribers is properly investment, and so may be added to the cost of the physical property. It is consistent even to consider the judicious rendering of free service, or of unprofitably low-rate service, for a time as legitimate investment adding to the going value of the plant.

The cost of duplication of physical plant is a comparatively simple calculation. The cost of duplication of franchise value is not a difficult matter to figure. The cost of duplication of going value is only determined by expert study of local conditions, estimating the expense and time of securing business and the factors which operate for or against development, as the character of the prospective patronage, nature of competition, growth of the community, etc. It is evident, however, that ex-

penses incurred through error in development study or engineering cannot properly be considered as legitimate. But since no development prediction is perfect, and few errors entirely without useful result, the dividing line is somewhat delicately situated. A certain factor of error is doubtless unavoidable in the development of any plant, and it seems reasonable to allow a definite percentage to that factor in calculating going value, since all must experience it.

There is naturally a limit to the inclusion of development expenses in going value. Such expenses may continue for an unreasonable time, or the operating company may be so managed that it has never shown a profit, in which case, if the rule were followed, the going value would increase abnormally. It follows that the appraiser must determine just where the inefficiency lies, and eliminate it as a factor in his calculations. In such cases, however, it will generally be found that the rates are too low, and a judicious increase will at once create a profit and put a stop to the climbing of the going value.

DEPRECIATION.

COMMENT is made in another editorial in this number on the complexity of the subject of depreciation; the term, generally used, including the divisions of decrepitude, obsolescence, required reconstruction, replacement after injury, and inadequacy. For an analysis of these causes we can do no better than to quote from a recent paper on the subject by William B. Jackson:

The term *depreciation* as here used may be divided into two parts:

1. Decrepitude—Which covers the gradual wearing out of the apparatus from the effects of use and of age, which cannot be overcome by current repairs, and which results eventually in ending the operative life of the apparatus.

2. Obsolescence—Which takes into account the reduction in the useful life of apparatus, on account of advances in the art whereby otherwise operative apparatus is made uneconomical for further use.

The term *reserve fund*, as here used, may also be divided into two parts.

1. Required Reconstruction—Which takes into account reconstruction costs made necessary by municipal or other legislative requirements.

2. Special Insurance—To cover expenses that cannot be forecast with any degree of certainty, caused by extraordinary occurrences such as unusual storms, explosions, great conflagrations, acts of strikers, etc.

In considering *depreciation* it is well to clearly separate in one's mind the annual depreciation of the plant as an average whole and that of the component parts of the plant, and the aggregate of these sums of money for all parts of the installation gives the annual depreciation for the plant. This may be converted into a percentage on the total value of the installation which is subject to depreciation. Any method of arriving at the amount of annual depreciation that does not take into account the individual depreciations of the component parts of a plant, must be an approximation at best, even though it may be based upon results obtained in a correct manner for other similar plants, and it may be very far from accurate.

This division of a plant into its component parts for purposes of determining its annual depreciation is usually a simple matter. It requires that each of the component parts shall be such that when it has reached the end of its useful life the part in its entirety will be discarded, and that it shall be possible intelligently to determine its probable salvage value as a whole. If these requirements are not fulfilled the part should be divided until they are.

The total amount of depreciation to be annually charged against any part of the installation should be equal to the first cost of the part installed ready for service plus the cost of removal, less any salvage obtainable for the part when discarded, divided by the years of probable life of the part.

In estimating the fair salvage value to be assigned to any part of an installation, it is often possible to fix it by some relation to the actual junk value of the materials comprising the part. For instance, the salvage value of a lead-covered, paper-insulated cable that has finished its useful life will be substantially the residue of the junk value of the lead melted off, and of the copper with the paper burned off after the cost of withdrawing the cable from its place of service and preparing the junk has been deducted, though sometimes cable rejected for use in one kind of service may be used in another.

The matter is not so simple with buildings and machinery. With the former it will frequently be found that the cost of removal will equal the junk value, and the salvage value is therefore zero; while with the latter the price that can probably be obtained from a second-hand dealer for the machinery in place may sometimes be considered as the salvage value, and in other cases the salvage value is the price that can be obtained from an old metal or junk dealer.

The factor of obsolescence entering into the question of useful life of plant, whether of buildings, machinery, or other plant, is a disturbing one. This has the effect of reducing the estimated useful life of many parts of most plants below that which would be indicated by the ravages of decrepitude, and it likewise affects the probable salvage. Where the factor of obsolescence is estimated as likely to terminate the useful life of a part before decrepitude would be likely to cause its rejection, the former factor must determine the useful life. Consequently, the factor of obsolescence may be the determining factor in fixing the length of the useful life of some parts of a plant, and decrepitude may be the determining factor in fixing the length of useful life of other parts. In other cases these two factors jointly may influence the length of life.

Most public service companies are forced to make large expenditures by ordinances of municipalities or by other legislative action. These are required changes, such as changes from overhead construction to underground construction, relocation of distribution lines on account of new street surveys, etc. The costs of such changes up to the value of the original construction should not be made an addition on capital investment and they cannot appropriately be considered as a part of current maintenance, but they should be provided for by a *required reconstruction* fund.

An adequate estimate of a suitable yearly contribution on account of required reconstruction, can only be accomplished after a careful study of what expenditures have been made in the plant under consideration, accompanied by a study of the district served by the plant with the view of forming a judgment of what requirements are likely to be imposed in the future. In the case of changes from overhead to underground line construction that are likely to be required, it is sometimes possible to make quite definite estimates of the cost of such changes for many years to come. And in some cases a regular schedule of such changes is determined by city ordinances.

The question of what annual charge should be made on account of *special insurance* is also difficult to solve with exactness, but it is one of which sight should not be lost. The ordinary maintenance expenses should not be expected to include such costs as those occasioned by destruction by a wind storm, the razing of a pole line by sleet, etc. It is, therefore, appropriate that an annual amount be laid aside for each part of the plant, except, of course, land, to create a fund to remedy such damages which come once in a while to every plant. The element of chance must enter very largely here, but chance is not such a fickle factor in operations when it effects are distributed amongst many parts of a plant.

These factors of required reconstruction and of special insurance, which I have considered under the heading reserve fund, are quite different in their characteristics from depreciation, but a plant will just as surely get into the breakers if its reserve fund, or some equivalent to meet these expenses, is not kept in good shape as when no provision is made to take care of depreciation.

A third division is sometimes made in depreciation, called inadequacy. This factor covers costs which are occasioned by the necessity of discarding otherwise serviceable plants on account of growth of business. This factor should be of small importance in a plant planned and operated with excellent engineering judgment, and it is so closely allied to obsolescence that it does not seem necessary to add a third division to depreciation. It may be properly considered as a part of obsolescence wherever it enters as an appreciable factor in any consideration of depreciation.

The Cedar Rapids, Iowa, Installation

By Gifford Wheeling

A NEW switchboard, with a capacity of 10,400 subscribers' lines and equipped for 21 operators' positions, was recently installed in the Cedar Rapids, Iowa, office of the Cedar Rapids and Marion Telephone Company. Cedar Rapids is considered a very good telephone city, and the new exchange equipment has been selected with a view to handling a traffic development that has always shown rapid increases.

Cedar Rapids Exchange, Cedar Rapids and Marion Telephone Company.

When a study was made not long ago of the telephone growth in Cedar Rapids, it was found that fifteen per cent of the population of the city are subscribers. This figure may well be contrasted with the development of Chicago, 7.1, St. Paul, 5.7 and Kansas City, 5 per cent.

Accordingly, the new switchboard is one which has been selected with a view to growth in the future. A board was chosen which could be made to grow to a large ultimate capacity with ease, and which was sure to give as good operating efficiency when the total capacity of the board was reached as at the present time.

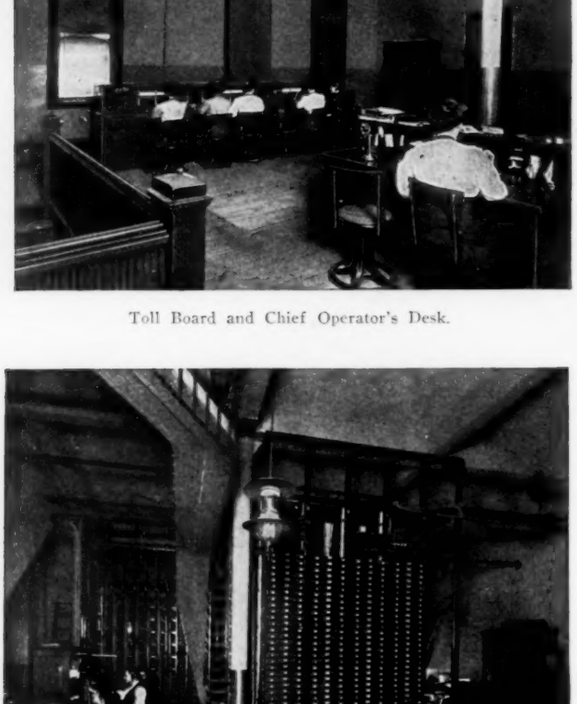
The board is a Western Electric No. 1, containing all of the newest appliances. The accompanying illustrations are excellent views of the operating room and the switchboard as it looks at present. The subscribers' board is divided into positions for local operators; toll switching positions, where the connection between toll board and local subscribers is completed; rural and night toll positions, for handling special traffic, and testing positions, in which is located the apparatus for testing circuits. The toll board consists of three No. 1 toll sections, each arranged for two operators' positions. The Mahogany exterior of the switchboard is simply a covering for the heavy steel frame, the details of which are so arranged that they support all of the apparatus and take all of the strain. In the rear of this board roller-curtains are provided, while in front removable panels allow ready access to the cords and apparatus.

Operating Room, Cedar Rapids.

For this board are used three-wire cord circuits of the repeating coil type, the efficiency of which is extremely high.

The chief operator's desk has capacity for two operators, who perform the usual duties of supervising the work of the regular operators. It has a capacity of twenty trunks from the subscriber's switchboard, over which any subscriber may converse with the chief operator. Ten circuits in connection with this desk are used exclusively for observing service given by operators and noting the language and deportment of subscribers as well as operators. Two-way trunks are provided with the chief operator's desk and wired to the wire chief's desk. Lines running to each of the operator's positions from this desk are so wired that the chief operator's telephone may be bridged directly across the telephone of any operator without her knowledge.

The wire chief's desk is arranged with sufficient testing circuits and plugged up lines to permit trouble to be rapidly cleared. The trunk lines connect various parts of the telephone system with this desk, bringing the wire chief into immediate touch with any part of the system. The toll board is of the multiple unit type, so arranged that by the addition of more operators' positions the ultimate toll business of Cedar Rapids can be handled.



Toll Board and Chief Operator's Desk.

Terminal Room.

Power Plant.

In the terminal room of the Cedar Rapids exchange building are located the main and intermediate distributing frames. Also in the terminal room is a relay rack which accommodates the line and cut-off relays. These relays are protected, as may be noted in the illustration, with dust-proof metal covers. When these covers are removed the relays become readily accessible.

The power board, which is constructed of Monson Maine slate, is shown in the same room with the power plant and the frames. Instruments are mounted on this board for measuring the charging and discharging current and voltages. It also contains automatic circuit breakers and fuses for protection as well as other reulating devices for controlling the supply of energy. A motor generator set of a type constructed especially for the noiseless charging of storage batteries is used in this power equipment and may be seen in the picture.

The equipment of the storage batteries furnished with this exchange has sufficient reserve capacity to carry the telephone office for 48 hours in case of accident to the outside power system.

Police Telephones in Lincoln, Nebraska

A new police telephone and signal system is being installed in Lincoln, Neb. Beginning with the installation of twenty-six boxes to be placed on corners as directed by the police chief, the plan is to develop as soon as possible a reporting telephone exchange which will reach all sections of the city.

Each station on the streets will consist of a metal box containing the necessary electrical equipment, mounted on a pole, something like a mail box. The boxes will all be locked and numbered. Every police officer will have a key and on opening a box will pull a small hook lever, which registers the number of the station at the police headquarters.

A regular telephone set will enable him to report verbally and receive any instructions that the captain may wish to give. If the officer should be in a hurry, with a prisoner waiting to be taken to the lockup, he will merely press a button and the patrol wagon will respond.

Provision is made for emergencies when no patrolman is in sight, enabling a citizen to get into the box and report direct to headquarters. This is a key to the lock, enclosed in a glass frame at the top of the box similar to the axe and water bucket seen in railroad cars for the use in case of fire. Nobody will be expected to break the glass and use the key except on very urgent occasions, and never in the daytime. The box is to be so arranged that a red light will go on when the key is taken from its receptable, so that if a policeman or anyone else is near his attention will be attracted.

At the police headquarters, there will be a switchboard, clock, time stamp and registering device, all working automatically when a report or signal is turned in from any telephone box. Communication will be instantaneous if the person at the switchboard is attentive to the calls coming in.

In order to meet the additional expenses which will be involved in the improvements and extensions which will soon be inaugurated by the Eastern Wisconsin Telephone Company, Chilton, Wis., the company has been authorized by the Wisconsin Commission to increase its rates from $1 and $1.25 per month, respectively, to $1.25 and $1.50.

How to Read Telephone Circuit Diagrams

By David S. Hulfish

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LESSON XVIII.

THAT a large number of sets of fixed contacts are accessible by the set of wipers in an automatic switch may be indicated very simply in a diagram. Fig. 548* shows in the lower portion a complete circuit for an automatic telephone switch. The set of movable brushes or wipers comprise the three brushes, *39, 40, 41,* which are shown in electrical connection with three fixed contacts and with the conductors attached to those contacts. Just above each of these contacts to which the conductors, *76, 115, 116,* are attached, are shown three isolated flat contact points, representing the contacts of another fixed set, and indicating that the brushes, *39, 40, 41,* have the ability to connect with any of a number of fixed sets.

In the diagram, Fig. 548, an off-normal switch is shown at *61*. The striker operating it is *63*.

The pilot of this automatic switch consists of four brushes and three sets of fixed contacts, each set of fixed contacts comprising four contact points. The pilot switch is not shown integral, but has its parts scattered through the diagram, presumably for the simplification of

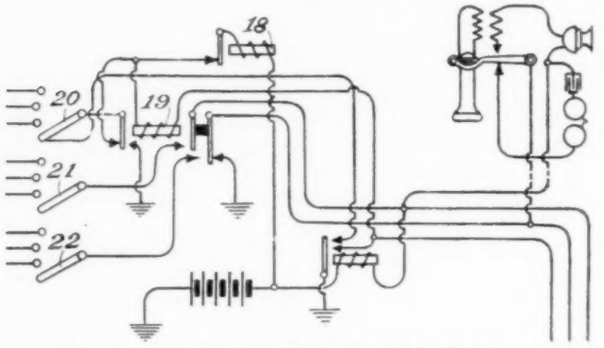


Fig. 566. Circuit of a Simple Automatic Switch.

the paths of the conductors leading to the pilot. The brushes of the pilot switch are labeled *43, 44, 45, 46*. They are shown in full lines in their first or normal position, and in dotted lines in their third position. The set of three circles adjacent to each brush represents the three fixed contacts available to that brush, one contact in each of the three sets of fixed contacts. There is a lack of uniformity in the separate parts of the pilot switch as shown, the first position of the switch being at the bottom in some of the parts and at the top elsewhere.

To read intelligently the diagram of Fig. 548, it is necessary to have a knowledge of the mechanism of the automatic switch whose circuit is shown at *C* and of the substation equipment shown at *A* as well.

The limit of the scope of the present series of articles is to teach the principles underlying the reading of telephone circuit diagrams. Another series of articles already in preparation will treat upon the subject of automatic telephony, its principles, its theories, its mechanisms, and the detailed reading of its circuits.

In Fig. 566, banks of waiting fixed contacts are indicated by the small circles adjacent to the wipers, *20, 21, 22*. In this diagram it would be necessary to have either some knowledge of the mechanism or a considerable skill in reading automatic diagrams to determine that the magnet *18* is the motor magnet for driving the brushes, *20, 21, 22*, and that the relay *19* is at the same time a pilot relay and the release magnet of the automatic switch. See Fig. 564 for details of the mechanism of the switch, and compare the label numbers. The

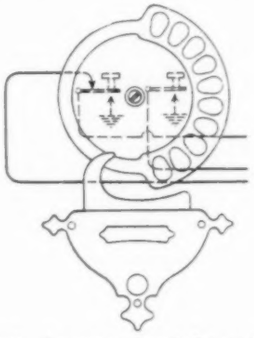


Fig. 567. Automatic Signal Transmitter.

automatic switch at the left of Fig. 566 responds when the receiver is lifted at the substation at the right.

Fig. 567 shows a symbol for a device for transmitting impulses of current for control of automatic switches. The two telegraph keys may be operated by the large dial surrounding them. This symbol is of peculiar construction in that it embodies a front view of a calling device and a circuit diagram of the

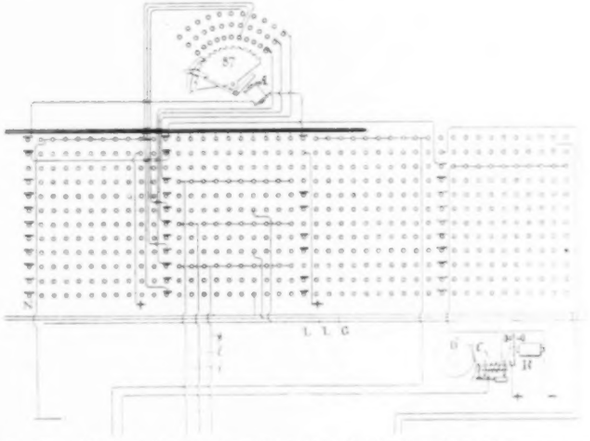


Fig. 568. Symbol for an Automatic Switch Having Two Movements of Selection.

device, drawn one upon the other to indicate their association.

An automatic switch is shown with all its fixed contacts in full in Fig. 568. An auxiliary switch, which in this instance is not a pilot switch, is shown at the top, at *87*. In this symbol, the fixed contacts are shown as small circles, and the brushes are shown as

*Telephone Engineer for April, 1910.

flat rectangles resting upon the circles. A device for controlling the movement of the brushes is shown at *C* and *D*, and itself governed in part at least by the relay *R*. When this device controls the brushes to move, all of the thirty-nine brushes move to the right over the contact points successively. The auxiliary switch, *87*, is controlled by the magnet *A*. To connect the three wires, *l, l, g*, to the three wires, *L, L, G*, it is necessary that the brushes of the lower or large

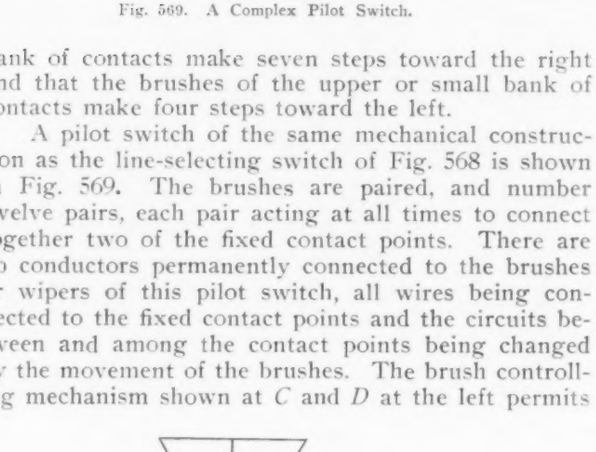


Fig. 569. A Complex Pilot Switch.

bank of contacts make seven steps toward the right and that the brushes of the upper or small bank of contacts make four steps toward the left.

A pilot switch of the same mechanical construction as the line-selecting switch of Fig. 568 is shown in Fig. 569. The brushes are paired, and number twelve pairs, each pair acting at all times to connect together two of the fixed contact points. There are no conductors permanently connected to the brushes or wipers of this pilot switch, all wires being connected to the fixed contact points and the circuits between and among the contact points being changed by the movement of the brushes. The brush controlling mechanism shown at *C* and *D* at the left permits

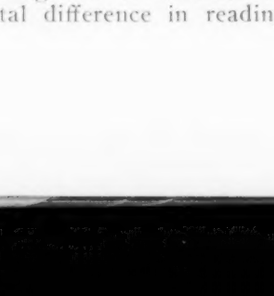


Fig. 570. Wireless Telephony.

the brushes to stop only upon those vertical rows of fixed contacts which are numbered at the top, *N, I, II, III, IV, V, VI, VII*. It is interesting to note that the brush controlling mechanism, *C, D*, is controlled to some extent through the brushes of its own automatic switch.

In circuit diagrams of wireless telephones, the only fundamental difference in reading will be encountered in the absence of the connecting line wires and the substitution of symbols for devices for launching the transmitted energy into space. In Fig. 570, this energy-launching apparatus takes the form of the ground wire *3* and the aerial wires or antennae *3'*. The winding *5* of the induction coil is connected to a telephone set usually highly specialized in mechanism and sometimes so in diagram, although usually embodying such symbols as have been discussed.

(The end.)

May Meeting, Pittsburg Section A. I. E. E.

A "kink" meeting was held by the Pittsburg section of the American Institute of Electrical Engineers at the lecture room, Carnegie hall, on the night of May 10. This meeting consisted of short talks on new methods or short cuts by a number of engineers representing various industries connected with the electrical profession.

Ralph W. Atkinson of the Standard Underground Cable Company gave some valuable information regarding the properties of insulating gums and compounds and results from testing the viscosity with a viscosimeter. By means of the tests and the determination of the brittleness he is able to classify compounds for various purposes, since his experience shows him that those compounds which are brittle become soft rapidly with rapid changes of temperature. By these classifications one can determine what insulating compound to select for use in impregnating, bearing in mind that the brittle compound will crack when subjected to sudden shocks. He uses the method for testing viscosity as described by Mr. Sanborn in the Electric Journal for March, 1910.

Henry W. Fisher of the Standard Underground Cable Company described a new method of measuring the viscosity of compounds, consisting of a simple steel cylinder bored with holes to hold the compound and the thermometer. This cylinder is so designed and operated that there is very little uncertainty about the temperature at which the compound melts. The uncertainty in this regard, as measured by the apparatus used by Sanborn, is his chief objection to that method and the value in the device suggested which can be made and used by anyone having any amount of mechanical ability.

F. K. Singer of the Central District and Printing Telegraph Company showed a typical trouble diagram of a telephone system with a view of exemplifying how any trouble in electrical circuits could be reduced to a system by a trouble diagram and then systematically studied out until by making certain tests and comparing the results with the trouble diagram, the defective element could be easily located with the least difficulty and delay.

In the discussion which followed the papers Mr. Henry Fisher described by request the new insulating material called "Bakelite," made by Mr. Baekeland and described at a recent meeting of the American Electric Chemical Society held in Pittsburg, May 7. Samples were shown and a statement of the method of manufacture from phenol and formaldehyde, with a discussion of the wonderful properties of the material for insulating purposes as the results of some experiments already made.

A Telephone Repeater and Stethoscope

By S. G. Brown*

THE telephone relay described is the outcome of six years' study, but has only been brought to its final form during the last eighteen months. Ever since the introduction of the telephone, a real need was felt for a telephone relay when it was discovered that the distance over which telephones could be used was comparatively limited. Many inventors have worked on the problem, and it has been declared by eminent telephone engineers to be insoluble. The telephone relay to be successful has to magnify in a continuous manner varying currents that are too feeble to affect properly a telephone receiver. Such currents would be of excessive weakness, say of the order of the one one-hundred-millionth of an ampere, and the mechanical movements produced by such currents, which have in their turn to bring about the increased electrical changes are, therefore, microscopic in dimensions.

The author's telephone relay has had to be developed along quite new lines. It takes as its basis the researches of J. J. Thomson. Earhart. Kinsley, and others, with regard to the flow of electrons across a microscopic airgap between two conducting surfaces at different potentials. Earhart made a series of experiments on the difference of potential required to produce sparks whose length is comparable with the wave-length of sodium light, and he found that when the distance between the metal electrodes falls to less than about 3×10^{4} cm., the spark potential falls off rapidly with the distance, and seems to become proportional to the distance; that is to say, when the electrodes are placed very close together, within a distance such

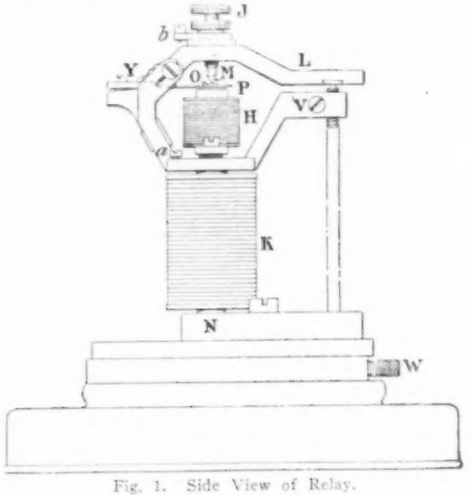


Fig. 1. Side View of Relay.

that the average intensity of force F between the electrodes reaches a value of about a million volts per centimeter, the discharge or current passing is determined by the condition that F, which is V/d, reaches this value (where V is the potential difference, and d the distance between the electrodes). If the metallic circuit of a dry cell be interrupted by a minute opening or space of the order of 5×10^{-7} cm., the metal at the point of interruption being platinum, the current will continue to flow round the circuit and across the opening, and any slight alteration in the length of the space, which I shall call the conduction space, will vary its resistance and greatly affect the value of the current that flows round the circuit. This conduction space is, therefore, exactly what is wanted for the

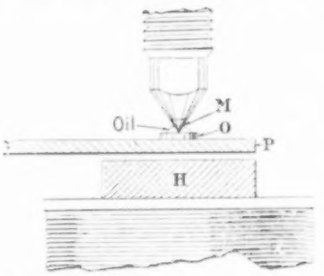


Fig. 2. Enlarged View of Reed and Contacts.

current-varying device of a telephone relay, where microscopic mechanical movements are to be transformed into large current changes. The dimensions of the conduction space are so small that it is difficult to ensure and maintain it by direct mechanical means. The current that flows across the space was, therefore, made to its own adjustment, very much in the same way as the current that passes through the arc of an arc lamp is made to strike and maintain the length of the arc.

Fig. 1 is a side view of the instrument with the brass cover removed. N is a permanent magnet, continued by soft iron poles right up to but not touching the "invar" steel reed P. Round the soft iron pole extensions are wound the two sets of coil windings H and K. The telephone currents to be magnified circulate round the winding H, and thus by varying the magnetism set the reed P in vibration. M O are the top and bottom metal contact-pieces, which are opened to an infinitesimal degree to form a microphone by the fine adjusting screw W and by the action of the local current passing through the contact and round the winding K. It is by the action of the local current operating through this winding that the conduction space is formed and afterwards maintained. So good is the automatic adjustment, that the instrument may be turned upside down, producing hardly any noticeable alteration in the value of the local current and without any effect on the working of the relay. The regulating winding K must not act when traversed by the rapidly varying telephonic currents; this is brought about by surrounding the iron under the coil by a closed circuited copper sheathing. Eddy currents set up in this sheathing by mutual induction destroy the self-induction of the coil.

Fig. 2 is an enlarged view of the reed P and the contact-pieces M O. In the present instrument the contact is made between metal pieces of hard osmium iridium alloy. The top contact is pointed, the lower one is flat, and is soldered to the reed; both are polished and work under a small drop of thin oil.

In earlier instruments the lower contact O was carried by a thin iron disc; the relay was then very

*Abstract of a paper read before the Institution of Electrical Engineers, London, England.

susceptible to outside noises. For this reason a reed is now used, it exposes such a small surface to the air that it is practically unaffected by extraneous sound.

Fig. 3 shows the connections of the relay. *C* is a dry cell (this is the normal voltage, which is as high as it is desirable to employ), *K* the low resistance regulating winding, *T* the receiving telephone or telephone headpiece of approximately 40 ohms resistance, *D* is an amperemeter or current indicator; when the microphone contact is opened so as to cut down the local current to half its maximum value, the relay is usually at its best adjustment. The telephone currents to be magnified enter by the terminals marked *A* and circulate through the winding *H*.

The relay will magnify the very feeblest telephone currents. Speech or signals that are too faint to be heard in the ordinary receiver may be heard clearly through the relay. If a watch be held against the ear-piece of a telephone the induced currents produced, when passed through the instrument, will reproduce the ticking in the receiver attached; this is a severe test.

As regards its utility on ordinary telephone lines, speech may be magnified many times in loudness without perceptible loss in the articulation, and it will work with large currents to a point at which the receiver in its local circuit is responding with uncomfortable loudness. In experimenting over a 20-pound standard cable and speaking only one way, it has been proved that, when the relay is applied, 30 miles may be added to any length through which it is possible now to speak direct. For instance, supposing the length of the core for direct speaking be 20 miles, this may be increased to 50 miles for the same loudness and approximate clearness when the relay is in circuit, either as a single repeater at the end of the first 20 miles, or as a receiver at the end of the 50 miles.

These tests prove that the telephone currents must be increased in strength to the extent of something like twenty times. If still greater magnifications are required than can be obtained with one relay, the simplest method would seem to be to employ two relays working in tandem. Their combined power would then be 400 times. In the majority of cases it is not necessary to add to the natural electrical damping of the reed, but if a piece of soft rubber be made to touch it, the voice can be transmitted with greater clearness even than if the conversation were taking place ordinarily in a room. This may be due to the complete absence of echoes.

By means of the local regulating winding (Fig. 2), the metal contact *M O* is transformed into the most exquisitely delicate microphone, more sensitive, there is every reason to believe, than could be formed by light pressure between carbons. Such a microphone has rendered possible the construction of an electric stethoscope, an instrument by the use of which the sound of the heart or other internal organs may be greatly magnified. This, I have been informed, may render it possible to detect in the earlier stages, heart disease, aneurism, and gallstones.

Fig. 4 is a diagrammatic illustration of the stethoscope. *A* is the front part, and consists of a shallow brass cell faced by a thin ebonite diaphragm. *A* is placed upon the part of the body to be examined, say, the heart; the beating of the heart is communicated to the ebonite diaphragm, then to the air inside the tube *B*, and thus the metal diaphragm *D* is set in vibration. *M O*, as before, are the osmium iridium contact-pieces. *M* is mounted on the diaphragm, and *O* on the steel reed *P*. The magnet *N S* and the reed are carried by a brass frame *E*, which is pivoted or hinged at the lower support *Y*. The conduction space is formed between the contacts *M O* by turning the fine adjusting screw *W*, and by the automatic action of the local current from the cell *C* flowing through the winding *K* and round the magnet. *T* is a special telephone transformer of equal windings of, say, 20 ohms resistance in the primary and in the secondary.

The electric stethoscope in its present form causes the sound of the heart to be three times as loud as in the ordinary stethoscope. This is scarcely sufficient for practical purposes. But if the telephone relay, such as I have previously described, be attached to the wires *x* of the transformer, the two instruments combined raise the intensity of the sound some twenty times and more, and this is ample for all ordinary purposes. The sound to be examined is picked up by the end of the tube *A*, and is heard in the telephones of a head-piece attached to the relay.

At the invitation of two physicians, I took the complete instrument, stethoscope and relay, to the London

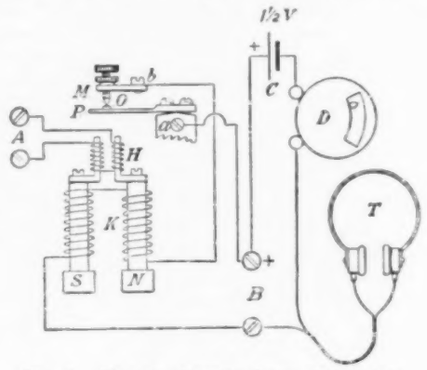


Fig. 3. Diagram Showing Relay Connections.

Hospital, where it was tested upon a number of diseased heart cases. When the instrument was applied directly to the heart the sound of the beats given out in the telephones was uncomfortably loud, and easily heard by the patient and all those that stood round, and this even if the telephones were in position on the head of the operator. The stethoscope as used increased the heartbeats to the almost complete exclusion of the shriller or breathing sounds. This has been brought about by mechanically tuning the disc *D* and the reed *P* of the telephone relay to the corresponding low note, and by a proper proportioning of the volume of air enclosed by the tube *B*. On other occasions, during private experiments, the instrument has been tuned so that nothing but the breathing sounds were audible, the passage of air through the lungs was heard as the roar of the wind through a forest of trees. This power of discrimination should be of service in allowing the independent examination of various organs of the body.

Replacing the telephone head-piece by a transformer, the stetoscope has been joined to the telephone service in my house, and for the sake of experiment, the sound of the heart has been transmitted over several miles of telephone lines to doctors in various parts of London and to other friends who were interested. All of them reported that the sounds received in the telephone were as loud and clear as when heard locally. The line, therefore, does not appear to produce

much loss or distortion. This trial proved that it is now possible for a specialist, say, in London, to examine a patient, say, in the country, stethoscopically, and to arrive at a correct diagnosis.

The instrument must of necessity, to replace the ordinary stethoscope, be more sensitive to sound than the human ear. This is proved by slight noises made in the room being heard in the telephones as loud noises. In consequence of this, the apparatus is padded and guarded as far as is possible from all outside disturbances, and the patient should be examined in a quiet room. If the instrument is provided with a small funnel in place of the tube *B*, it will pick up and magnify the slightest sound, and ordinary speaking may be increased to a deafening shout in the telephone. Such an instrument, when properly constructed for the purpose, may be of use to those who are afflicted with deafness.

The relay has been used on the electrophone system, and by its aid, damping the reed with a piece of rubber, the speaking and music from the theaters are rendered with greater loudness and clearness, and by adding a loud speaker with trumpet the sounds can be heard in the room.

I come now to a subject that is interesting me greatly —it is still a matter of experiment—the production of a clear and loud-speaking transmitter. Such an instrument would give considerable comfort to the subscriber, and might save hundreds of thousands of pounds worth of copper for the companies. I am under the impression that the carbon transmitter has been developed to its full extent, ceaseless efforts having been directed to this end by the engineers of the large telephone companies.

To make progress towards an ideal transmitter, carbon had, therefore, to be abandoned, not because of any serious defect in its microphonic qualities, which are good, but because of its bad conducting power. It would not transmit enough energy. One must pass much current in order to speak loudly, and a material was wanted

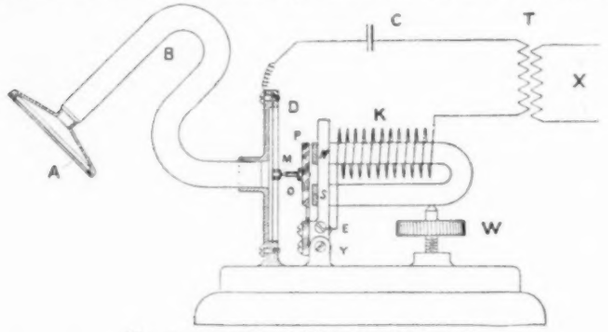


Fig. 4. Diagram of Electrical Stethoscope.

that not only would conduct well, but would change its resistance to pressure more readily than carbon. I am pleased to say that I have discovered something that carries out my wishes well in both of these directions.

During some experiments with the telephone relay, attempts were made to dispense with the regulating winding, and form the microphone by the mere pressure of the electrodes one against the other as with carbon. With gold, platinum, palladium, and rhodium, it was not possible to do so. On the contrary, a microphone could be formed by light pressure between the following: Iridium, ruthenium, osmium, and osmium iridium alloy. They are arranged advancing in the order of their effectiveness, which likewise is the order of their hardness. With iridium the action was only just shown, while osmium iridium alloy makes a microphone that can carry large currents, stand high temperatures, and is exceedingly sensitive to small changes of pressure. This alloy is by far the best of the whole series, as it is the hardest, and, although expensive, can be readily purchased as natural grains or granules, sifted to any desired uniform size. As regards the effectiveness of carbon, I should be inclined to include it in the series between iridium and ruthenium. The chemical properties of carbon, ruthenium and osmium have likewise much in common, in that they resist the action of all acids, and are carried off as a gas by oxygen when strongly heated.

Ruthenium and osmium are of little value for microphonic purposes if purchased in their commercial form as grains or powder. The grains must be first fused

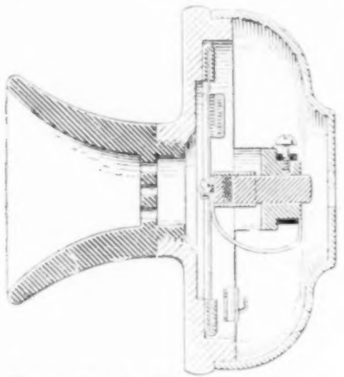


Fig. 5. Metallic Electrode Transmitter.

into a bead and then crushed into granules. This may account for the failure of previous experimenters, who in their endeavor to compete with carbon, tried nearly everything that could be mentioned, including ruthenium and osmium, but without success.

Several "solid back" transmitters have been taken and altered in various ways to make use of the new metal. In one case, the ordinary carbon electrodes were entirely removed and replaced by sheet iridium-faced ones 3-16 inch in diameter; these electrodes were separated by a distance of 1-20 inch, and the space between was nearly filled by three grains weight of very fine granules of osmium iridium kept in place by a rubber tube. This new transmitter would take permanently a current of ¾ amperes from a two-volt accumulator. It was connected to the telephone service through a large transformer, which had a low-resistance primary of only 1-10 of an ohm. The ordinary carbon transmitter, supplied in the usual way from the central battery, was kept in position in series for purpose of comparison. The results of several trials were as follows: Speaking on both occasions with equal force, first, directly into the mouthpiece of the carbon transmitter; secondly, twelve inches away from the mouthpiece of the metal transmitter, the same volume was given in the receiving telephone. When the new transmitter was spoken into at a distance of three inches, the sound was two or three times louder than is at present normal and when spoken into directly, the sound at the far end was uncomfortably loud and the voice could be heard with ease three yards away from the receiver. In all cases the articulation was clearer and crisper with the metal than with the carbon transmitter.

The first difficulty to contend with occurred after the instrument had been in use some months. This was

a gradual weakening of the power of transmission, which was eventually found to be due to the iridium faces of the electrodes becoming superficially oxidized. To remedy this, the iridium has been replaced by gold, which so far has proved satisfactory. Another improvement was to come inwards the faces of the gold electrodes; this is to prevent the granules from unpacking, as they had previously a tendency to do when worked between plane faces.

An osmium iridium granular transmitter has been constructed embodying all these later improvements (Fig. 5.) The electrodes have a diameter of ¼ inch, and it will work permanently with one ampere at two volts. When joined to the telephone circuit and spoken directly into, the distant receiver will respond with overpowering loudness. Such an instrument could be fitted in subscribers' premises where long-distance telephony was much in use, and distances could be spoken over which at present offer considerable difficulties. Up to the present no regular long-distance tests have been made, but it has been tried over 60 miles of 20-pound standard artificial cable, and will work over this length with clearness and reasonable loudness, showing that this was by no means the limit. In all these trials a local battery was used. As most of the transmitters in London are supplied with current from common or central batteries at the exchanges, it would be important to adapt the new instrument to this system, but up to the present nothing has been done in this direction. The metal transmitter has a low resistance; this would have to be raised by a suitable design to make it really successful. The amount of current received over the telephone wires at my house is only 0.06 ampere, supplied by, I believe a 22-volt accumulator, working through the 360 ohms of the line. On one occasion, as an experiment, the central battery carbon transmitter was replaced by an ordinary low-resistance metal one, and at the far end clearer speech was obtained, which was as loud as before. The upper harmonics of the voice are more faithfully transmitted by the metal granules than by the carbon—this accounts for the superiority in the articulation. As metal replaced carbon in the incandescent lamp to improve the efficiency, it would be curious if it should be doing the same thing now with the telephone transmitter. A much smaller quantity of the metal powder or granules is required as compared with carbon, and its sensitiveness in resistance to small changes of pressure is much greater; the new material is, therefore, peculiarly adaptable for the purposes of a relay for use on telephone lines where moderate magnification only is required. Such a relay has been constructed using osmium iridium powder as the resistance varying medium; it is simple in design, requires no adjustment, and so far gives a moderate magnification with good articulation.

Referring to the telephone relay, the efficiency of the microphone for speech transmission depends largely upon the metal employed for the contact. Experiments have been made, with the following results. The metal must be unoxidizable. Thus materials like brass and aluminum are useless. If they partially oxidize like steel and silver, the magnifying power is small. With the following, good results were attained: Pt, Pd, Rh, Ir, Ru, Os, and osmium iridium alloy. Carbon has been tried for one or for both of the contact-pieces; the magnifying power is then smaller than with the metals, and less current can be sent through due to its greater specific resistance. Gold, due to its complete absence of surface oxidization, makes an unstable contact, and the relay will buzz, very much after the fashion of an electric bell, under all ranges of adjustment. (Soft pure gold makes the best contact for an ordinary relay of any material that I am acquainted with.) Even with the metals of the platinum group, the relay can be made to buzz by cleaning the contact with a cloth, but stability of working can be again secured by oxidizing the surface, by exposure to the air, or, what is much better, by applying thin oil to the surfaces of the contact. The nearer the relay is to this buzzing point, the greater the sensitiveness; it is, therefore, advisable to clean the contact so as to obtain the buzzing action and to stop the action by the application of a small drop of thin oil. The harder the contact metal used, the clearer the speech through the relay. With soft platinum the higher harmonics are more or less absent, but with osmium iridium the articulation is quite clear and crisp.

Microphones are sometimes liable to produce faint bubbling and speaking sounds; this is due, I think, principally, to want of hardness in the contact-pieces, especially if the upper bruises the lower piece. This sound can usually be stopped by shunting through a suitable resistance the winding of the telephone circuit. A microphone formed between two hard metals can touch only in one spot. As half the energy liberated from the local battery is normally dissipated at this point, the rise of temperature there may be very considerable. This heating puts a stop to any great handling of power by a single contact. For these reasons it is not advisable, with the normal voltage to pass more than, say, ¼ ampere; if the current is too great, the sensitiveness will decrease with time; but if the current is kept small, say, of the order of 1-20 ampere, the delicacy may be perpetually maintained. It is fortunate that the harder varieties of the platinum group are the ones that are able to stand the higher temperatures.

The following rough tests of a special form of my telephone relay may be of interest; the resistance of the coil through which the current to be magnified passed was in this case 1,000 ohms. 0.126 milliamperes switched on through this coil caused the local relay current to vary from 3 to 0.5 milliamperes, the contact volts from 0.36 to 1.19, the contact resistance, as calculated, from 120 to 2,370 ohms, and the measured movement of the reed at the place of contact, 8×10^{6} inches. With the contact open and no local current, placing a 10-gramme weight on the reed near the contact produced a measured movement of 2.4×10^{5} inches. With the contact adjusted to pass 4 milliamperes, the 10-gramme weight cut the local current down to 1.5 milliamperes and produced a movement of 1.2×10^{5} inches, and with 25 milliamperes the same weight reduced the current to 20 milliamperes and caused a movement of 0.6×10^{5} inches. We have thus the curious effect, that with a given applied force increasing the local current cuts down the movement of the reed. Perhaps this accounts for the fact that, within wide limits, altering the resistance, and thus the value of the current in the local circuit does not seem to change the magnifying power of the relay; this power is more a question of contact and voltage than anything else. If a telephone relay is required to have a high degree of sensitiveness, the voltage of the local cell must be reduced to, say, half a volt. This low voltage can be secured by opposing an accumulator to a dry cell, but the arrangement can only be at the expense of the self-regulating power of the microphone.

A telephone relay, if placed simply in the middle of

a long telephone line, can magnify the currents only in one direction—such a device is called a single repeater. The relay for practical use has, therefore, to be associated with balancing coils and placed in the line so that it may work in either or both directions—such a combination is termed a two-way repeater. In a two-way repeater the lines on each side of the coils have to be balanced one against the other, and anything that produces a variation, say leakage, will cause the relay to react upon itself and thus interrupt the conversation till the balance has been restored. Theoretically, it would seem that the two-way repeater can be only one-quarter the efficiency of the single repeater. Although the one-way relay is now solved, it will be seen that there is still much to be done before the two-way repeater is practicable.

Special Systems for Stock Brokers

By H. A. Shepard

THE Chicago Stock Exchange has a unique system of private line telephones operating in its new exchange. This question of private line telephones was considered of the utmost importance in transmitting rapid secret orders and messages between a broker and his office. The old hand generator system installed by the Chicago Telephone Company was found inadequate; so W. J. C. Kenyon, then vice-president and general manager of the Illinois Tunnel Company, with the assistance of S. S. Stolp, signal engineer, installed the present private line system. This was found very satisfactory, and answered in every way the demands of this kind of service, which is unique in this particular. The working hours of the stock exchange are not as long as the usual working day and the broker and his telephones are sometimes pushed to the utmost, and very accurate transmitting and receiving are necessary to the correct execution of his orders.

At present 35 private line telephones have been installed in the exchange-room. Each system consists of two Automatic Electric Company's desk telephones, with the dial mechanism taken out; the general appearance being that of an automatic telephone. One is placed on a mahogany shelf at the stock exchange, at such height that the broker is in a standing position when talking, and the other in the home office. The exchange telephone has an aluminum name plate, engraved with the name of the brokerage house, which is mounted on the front of the mechanism case in place of the dial. In series with the usual call bell, there is mounted a neat brass bracket enclosing a miniature incandescent lamp with either a red or green glass lens. The whole closely resembles an automatic tail lamp. The signal case is fastened beneath the mechanism shelf, and the signal light is mounted above the telephone, at such height that it is easily seen from any part of the exchange-room. The red and green signals are mounted alternately so that confusion from this source is avoided. Boys are stationed at convenient points whose business it is to watch the signals, and call the name of the broker wanted if he does not see his signal lamp burning at its first flashing. At the broker's office his telephone is practically the same, except that he has no signal light, his calling equipment being the ordinary call bell. In calling his man on the stock exchange he presses the key momentarily on the side of his telephone without taking off his receiver. This operation lights the lamp signal at the stock exchange, and it remains lighted until the call is answered. In the event that the brokerage office has only pressed the key, and is so busy that the caller is not holding the line waiting for the broker, it is only necessary for the latter at the stock exchange to ring his office by pressing his key. If one of the stock exchange telephone receivers has been left off the hook, or the incandescent lamp signal is burnt out, the office man when calling rings a bell instead of lighting a lamp, which notifies the boys on the exchange floor that a receiver has been left off the hook or lamp burnt out. If the receiver is off the hook at the office end the bell will ring the same as if the receiver was in its proper place.

The installers of this system have attempted to make installations absolutely fool-proof, and have taken many steps seemingly unnecessary to keep the service in working order. It may mean thousands of dollars to a brokerage company if its accommodations with its broker on the exchange floor should be cut off for any length of time, and the corrective measures that the installers of the above described system have used are warranted to keep the line in condition through fire, cyclone or any other untoward disturbance. Since the date of this installation the secretary of the Chicago Stock Exchange has reported a perfect working private line telephone system and it is to be hoped that the comparatively inexpensive system and its many advantages will be appreciated by other stock exchanges or work the nature of which demands a very accurate and exacting service.

All large brokers have made accommodations in their offices for the rapid transmission of sales on the exchange to their blackboards for the convenience of their customers. In this way much of their business is transacted on the floor of their blackboard room, and it is no uncommon thing for 75 to 100 men to arrange their business transactions in this one room at the same time. So the Chicago office of S. B. Chapin Company has recently installed a signal system operated at its switchboard and intended to secure the immediate attention of its solicitors and give them connections by telephone with the switchboard. In connection with this switchboard specially constructed switches for lighting and extinguishing incandescent lamps in the exchange-room have been installed. The switch box is placed convenient to the telephone operator, and the signal lamp is mounted on the panel of the broker's blackboard. At one end of the room a pilot lamp with a large sized globe is placed in a conspicuous position, which lights at each signal from the operator. The number of switches in the switch box corresponds with the signal numbers to be flashed

on the panel of the blackboard, and can be increased with the addition of each new solicitor. These signals are of special design, frosted white glass, mounted in brass and numbered. A natural red glass incandescent lamp is back of the signal.

The method of operation is simple and yet accurate. It secures the immediate attention of the solicitor desired, and avoids the noisy, inconvenient method formerly used, that is, sending a boy to advise the solicitor that a certain party desiring certain information is calling him on the telephone. When the operator receives a call for solicitor number one he presses number one switch, lighting number one signal on the panel of the blackboard, as well as the pilot lamp at the head of the room. This signal remains set until the solicitor answers his call on the nearest telephone. The operator on receiving his answering signal presses the extinguishing switch. If the solicitor does not answer his call within fifteen seconds the pilot lamp flashes automatically, but the numbered signal remains set. This intermittent flashing of the red pilot lamp is very noticeable, and if the solicitor is in the room he will be attracted by it, and will then look at the blackboard to see if his number has been called. If he does not answer his call within a minute or two the operator presses the extinguishing switch, and knowing that he is not in the room, can so advise the man inquiring without any further search.

Both of the systems as outlined above, that of the Chicago Stock Exchange and the brokers telephone signal system are adapted to so many uses needing an accurate and yet specially designed signal system that their inventors have a wide field.

Telephone History Among the Indians

The first telephone plant in Oklahoma was built by Cherokee Indians under permission obtained with much difficulty from the Cherokee Tribal Legislature. This was in 1886, ten years after Alexander Graham Bell had constructed his first successful telephone instrument. This pioneer telephone line ran from Tahlequah, the Cherokee capital, to Muskogee, and was looked upon as something supernatural by many of the Cherokees. The original promoters of this toll line were J. S. Stapler, Henry Eiffert, D. W. Lipe and L. B. Bell, all of Tahlequah, and most of whom are living. The work of actual construction was directed by E. D. Hicks of Tahlequah.

In the early eighties the Indian Territory was a vast wilderness. There were few towns, and communication with the outside world was slow and difficult. In 1885 a few progressive business men at Tahlequah saw the necessity of being in touch with civilization by some means other than walking or going on horseback or in wagons. Muskogee was the nearest telegraph station, and at first a telegraph line to Muskogee was planned. Telegraph operators, however, were scarce and high-priced in the Indian country, and material for line building was expensive. The plan for quicker communication had been almost abandoned when news of the success of the telephone found its way to Tahlequah.

The telephone of that day was as unlike the telephone of this day as a native of Uganda is unlike a Parisian aristocrat. Five telephones were ordered, at $75 each, or $375 for all; twelve cents a pound was paid for iron wire and seven cents for each insulator. Wet batteries were used, and their price was high.

No sooner did the Tahlequah promoters begin moving than they stirred up trouble for themselves. The Cherokee legislature was controlled by non-progressive full-blood Indians, who were violently opposed to anything that looked like the encroachment of white men and the ways of white men. They argued that when a wire was stretched railroads, which they feared and hated, would follow; furthermore, they "did not believe a wire could talk, anyway." A couple of vibrators were used to explain to these Cherokees how the telephone was operated. The vibrators were handled by three full-blood Indians—Soggy Sanders (Sargeyas), Tom Smith (Talaki), and Daniel Gritts (Westuxula)—before the assembled legislators, who grew excited and crowded around to see the wire "talk," not only in English, but in Cherokee. The chief of the Cherokees at that time was D. W. Bushyhead (Tsunuluske), a man of liberal mind. After prolonged debate a bill was passed by the Cherokee council allowing the company to build a line from Tahlequah to the west boundary of the Cherokee nation, three miles from Muskogee.

Construction was soon under way. Native oak poles were cut and peeled and the butts charred. In the twenty miles from Tahlequah to Fort Gibson only about three full miles of poles were needed, trees being used for the remainder of the distance. The workmen carried small ladders for climbing, linemen's climbers being an unknown device in that wild and woolly country.

Equipped with a camp outfit, the gang started without thought of a survey of the most feasible route. Men familiar with the country were employed to locate the most difficult—not the easiest—route, the purpose being to offer no encouragement to the building of a railroad. This precaution was due to a stipulation in the act of the Cherokee council. If the guides, after building a mile or two, found that the direction was wrong, a jog was made to get back into line. If a house was passed where the occupants were superstitious or otherwise afraid, the line was built around it and far enough away to allay their fears.

By the fall of 1886 the line had been carried to Fort Gibson, and the telephones received. Installations were made, and everything declared ready for the official "test" when—not a sound could be enticed from the instrument. A soldier in the garrison at Fort Gibson fortunately had seen telephones used in Eastern States and volunteered his help.

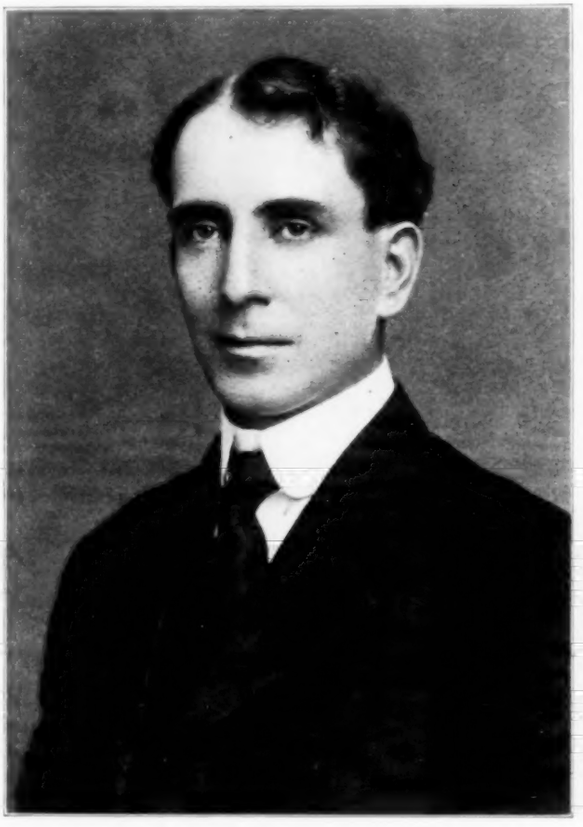
When the Fort Gibson end finally was put in what the soldier said was working order, a message was dispatched post haste to Tahlequah with detailed instructions how to put that end in working order. In several hours a ring was received at Fort Gibson, the first ring of a telephone bell in actual operation ever heard in Oklahoma, and the conversation that followed not only marked an epoch in the advancement of the Cherokees, but astonished beyond expression the full-bloods that were present.

Shortly afterwards the line was built into Muskogee. The crossing of the Arkansas river at first seemed insurmountable. The wire would break if pulled too tight or be broken by driftwood if left too slack. The span was more than 1,200 feet. A copper wire, No. 6, was bought at a cost of $105 and used in lieu of the weaker iron wire. Hard drawn copper wire was unknown at that time, and there was never a pair of suspenders that had more stretch to them than did that famous No. 6. It finally went into the river, and probably still lies somewhere in its sands. A No. 12 iron wire was hung in its place, and gave good service for several years.

Who's Who in the Telephone Game

Facts and Fancies About a Man You Know or Ought to Know

THE panic of 1893 was to blame for it. That year, among the graduates of the University of Wisconsin, was James Glendenning Wray with the degrees B. S. and E. E. He forthwith journeyed to Chicago where he accepted a job with the Chicago Telephone Co. at $30 per month—not much, to be sure, but boys of 21 are usually willing to start, whether the price is right or not. Then something happened. During his school days, young Wray had covered the Wisconsin legislature for the Chicago *Record* and Chicago *Times*. He had made more than a local reputation for himself as a newspaper man. When Col. Plankinton and his associates started a big democratic daily in Madison, Wray did some special work for them. About graduation time the daily was moved to Milwaukee and Wray moved to Chicago, and about the time the daily got settled in Milwaukee and Wray was settled in Chicago, the daily wanted a managing editor. An offer came to Wray to accept the position and he lost no time in doing so because there was a marked difference between $1,800 a year and $360 a year.



You Would Pick Him for a Faculty Man.

But the panic of '93 was to blame. It brought about the failure of the Plankinton Bank and with the bank went the democratic daily and the $1,800 job. Wray journeyed back to Chicago on the last piece of newspaper transportation he has ever had and he went to work again for the Chicago Telephone Company, but not at $30.

That was seventeen years ago and he has been through the big mill from the depth of the deepest manhole to the tallest pole. He has had practically every job on the ladder from the bottom rung to the top of the sixth extension, for he is the company's chief engineer. If patience, persistence and perseverance count, here is a fine example.

Harking back a bit, Wray was an ambitious student—is yet, for that matter. During his school vacations he devoted his time to practical work. He was assistant to the county surveyor. One year he joined the United States Geological Survey under Dr. Van Hise, and explored the northern peninsula of Michigan. He was assistant to the city editor and, for a brief period, city editor of the Madison *Times*. If disaster had not wiped out his more pretentious experience at Milwaukee he might have been lost to the telephone world. He surely would not have been the inventor of the keyless trunking system now in general use by the licensee Bell companies in all large cities.

Chief engineer of the Chicago Telephone Company is a whole man's job. All specifications for all material entering into the big plant, inside, outside and underground come under the observation of the department. The fundamental plan—being a prophetic study of future requirements—is the big problem. It is revised occasionally, but it is a never-ending study and has a large influence upon all development work. All buildings are planned, constructed and inspected in Wray's department. Central office switchboard and equipment; plans for heavy outside construction, including such work as underground trunks to Milwaukee; equipment development study; cost of service; experimental laboratory—all directly under the chief's supervision. Sixty telephone engineers find plenty to do in the chief engineer's offices. It is some job—too much to tell in limited space.

Besides the detail such work involves, James G. Wray is active in clubs, church and Sunday School. He teaches a class of college and high school boys at the First Congregational Church, Wilmette. He is married and is the father of five children. He is a member of the Chicago University Club; the City Club; the Ouilmette Country Club—plays golf—University Club of Madison; American Institute of Electrical Engineers; Western Society of Engineers; Illinois Engineering Society; Wisconsin Society. His activities in these organizations include chairman Chicago section of A. I. E. E.; chairman joint committee representing the A. I. E. E. and electrical section of the Western Society; member official board of visitors, University of Wisconsin as well as executive committeeman of the alumni association of the same institution; director of the Chicago Missionary Society, besides minor affairs.

Wray hardly looks or acts the part. He is slightly under medium size and weight. You would pick him for a faculty man. His eyes are well set and are surmounted by heavy brows—almost shaggy. He is parting his hair in the middle, because it is getting thin on his forward dome. With discrimination there is enough left to

make a fair showing, but he will be bald afterwhile.

No one ever calls him Jim or Glen. It is Mr. Wray —a superior in many ways. A big man, big enough to make a place for himself in one of the biggest operating telephone companies of the world. He was born in Janesville, Wisconsin, May 19, 1872, and for a quiet, soft-spoken young man, you must acknowledge that he has made a notable dent in the crust of one of those alleged-to-be hard-heated corporations which should inspire hope in the hearts of his fellows.

Items of Legal Interest

By Ralph M. Loring

MONOPOLY.

A contract between two telephone companies having connecting exchanges gave each the exclusive right to have transmitted over its lines all messages coming from the lines of the other destined to points on the lines of the connecting company not reached by the lines of the other company, and provide that the connecting carrier should receive for its service a percentage of the charge made, to be determined on the basis of the relative number of miles the message was transmitted on their respective lines. Rev. St. 1899, sec. 8978 (Ann. St. 1906, p. 4157), forbids two or more corporations engaged in buying or selling any commodity, convenience, or thing whatsoever to agree to limit competition by refusing to buy from or sell to any other such article or thing for the reason that such other is not a party to such agreement or combination. *Held,* that telephone service was a "convenience or commodity" within the statute, and the contract was void for prohibiting the parties thereto from buying such service as to messages destined to points on the lines of the other from other companies, and attempting to create a monopoly as to such business. *Home Telephone Co. v. Granby & Neosho Telephone Co. St. Louis Court of Appeals, Missouri.* 126 *Southwestern* 773.

INJURY TO SERVANT.

Plaintiff and another were experienced employes of a telephone company employed to take out telephones from residences and remove the wires, and, when plaintiff was injured, they were engaged in taking down a wire which ran from a pole over a trolley wire to the house, the end of the wire attached to the telephone having been removed, leaving the wire attached to the house and to the pole, and when the other workman detached the wire from the pole, it fell on the trolley wire, shocking plaintiff, who at the time was holding the end of the wire detached from the telephone. The telephone wire was not insulated as was usual where it went over a trolley wire, and plaintiff and the other could see that it was not insulated at the ends which they handled, but plaintiff did not know whether it was insulated over the trolley wire. A rope was furnished for taking down wires in such cases so as to avoid danger, but plaintiff did not use it. *Held,* that the proximate cause of plaintiff's injuries was the failure to use the rope in taking down the telephone wire, and not the lack of insulation. *Wight v Cumberland Telephone & Telegraph Co. Court of Appeals of Kentucky.* 125 *Southwestern* 718.

OBLIGATION OF MASTER.

An agreement between a telephone company and a power company provided that either might attach its wires to the poles of the other by paying a rental therefor. The telephone company transferred its wires from a pole of the power company to a pole of its own about five feet away. Thereafter the foreman of the telephone company attached to the power company's pole a cable seat for use in splicing the telephone company's cable. The use of the pole was convenient, but not necessary. There was nothing to show that the telephone company or power company knew that the pole was being so used. *Held,* that the act of the foreman amounted to an adoption of the power company's pole as a means of access to the work to be performed, and the telephone company was required to make the place safe for its employés. *Miner v. Franklin County Telephone Co. Supreme Court of Vermont.* 75 *Atlantic* 653.

WARNING OF EXTRA DANGERS.

A clause in a telephone company's "notice and rules" that electric light and power wires, whether insulated or not, may be dangerous did not exonerate the company from liability from injury to an employé from a defectively insulated heavy voltage wire of an electric company strung on a telephone pole; the fact that the wire was insulated being in effect notice to the servant that he might rely upon whatever safety and protection the insulation of wires secures to linemen working on poles on which such wires are strung. *Speight v. Rocky Mountain Bell Telephone Co. Supreme Court of Utah.* 107 *Pacific* 742.

DISCRIMINATION.

While a telephone company is a quasi public corporation, and has no right to exercise unfair, unjust, and unreasonable discrimination as between those similarly situated, that a telephone company allowed a discount of 25 per cent to clergymen, to charitable institutions, and to the city of New York, did not amount to an unfair or unreasonable discrimination, as against a business corporation conducting a department store requiring extensive telephone service. *New York Telephone Co. v. Siegel-Cooper Co. Supreme Court of New York.* 121 *N. Y. Supp.* 1033.

ASSUMPTION OF RISK.

A servant entering the employ of a telephone company to work, on its poles and wires, assumes the minor risks incident to the employment, and such dangers as are obvious and apparent, but not such extra risks as might arise from the master's failure to use ordinary care to keep properly insulated wires, carrying heavy currents of electricity, strung upon its poles, where the servant is to work, unless such extra dangers are pointed out to the servant. *Speight v. Rocky Mountain Bell Telephone Co. Supreme Court of Utah.* 107 *Pacific* 742.

Notes on Splicing Cables

By an Old Cable Splicer

IT should be the endeavor of those in charge of the installation of the cable plant to bestow upon the matter of splicing extraordinary attention. The interruption to service and damage to the cable plant resulting from poor splicing may be of the most serious nature. The trouble caused by bad splicing does not necessarily show itself at once. It is, in a large number of cases, caused by defects which only become apparent as trouble after an extended period of service or when the cable plant is subjected to severe weather conditions. If rigorous attention is not given to the making of each splice, the cable plant will, in the course of time, get into a condition of general debility. Such a condition will necessitate the expenditure of considerable money and require great skill to overcome. It may even involve the entire reconstruction of the cable plant. In such cases, even with the best of skill, the cable plant, once having deteriorated, can never be brought to its highest efficiency. All of this is quite independent of the bad reaction which a run-down plant creates upon the telephone service.

After the work of splicing has been completed it is not possible to determine by an inspection of the cable whether it has been done well in all respects. Nothing but constant vigilance will save a cable plant from progressive decay. The most important place and time at which to exert this vigilance is when the actual work of splicing is being done.

The following notes are intended to outline approved methods, together with the materials required, for splicing lead covered, paper insulated telephone cables.

The splicers should be provided with diagrams showing the present condition of the cables, proposed changes of additions, splicing details and location of terminals, together with instructions from the foreman in charge of the work.

AERIAL CABLE.

For splicing aerial cables, suitable platforms should be provided for the splicers to work upon, together with

Fig. 1.

the necessary guy ropes, tackle and hand lines. The platforms should not be too large or heavy, in order to facilitate placing them in position and moving from one splice to another. Each splicer should also be supplied with a tent or approved equivalent for protecting the splice while working in inclement weather.

Location of Splices.—At terminal and branch poles, the splice should be so located so that its center will not be more than about three feet from the pole.

Where wires are left dead in a tap splice and the cable is to be extended at some future time, a sleeve large enough to allow for the extension should be used. Pairs which are left dead in a splice should be insulated by having one wire of the pair bent back on itself and a paper sleeve slipped over the end of the pair.

Setting Up.—Short bends should be avoided where the cable leaves the strand and on the pole beneath a terminal. Care should be taken to make these bends as gradual as possible so as not to kink the cable. A lashing or clamp should never be placed near the center of a bend where a cable passes up or down a pole.

UNDERGROUND CABLE.

The splicers should be provided with suitable tents and manhole guards for protecting the manhole openings. Care should be exercised by the splicers to detect the presence of gas before entering the manholes.

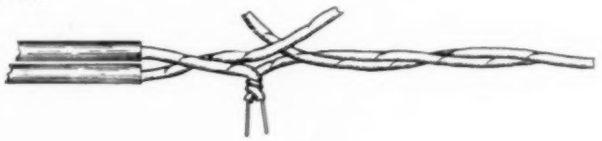


Fig. 2.

If the presence of gas is detected they should not enter the manholes until the latter have been thoroughly ventilated. In subway systems, where gas is prevalent in some of the manholes, only approved safe lights should be used throughout the entire system.

Setting Up.—Where several sections of cable have been run, an inspection should be made to determine if there is sufficient end in all manholes to permit of the proper setting up of the cable. This inspection should be made before the work of setting up the cable is started in any of the manholes. If it is found that there is not sufficient end in any of the manholes, slack should be obtained from the adjoining manholes, if possible.

The cable should be kept straight out from the duct for a distance of about four inches, before making the bend. In bending, care should be taken not to buckle or kink the cable. If it is found necessary to use a dresser, it should not be used to the extent of weakening the sheath. If the end of the cable is opened, it will facilitate the bending of the cable.

Short bends should be avoided. Cables should be set in a position on the wall corresponding to the duct in which the cable has been placed. Great care should be taken to avoid crossing over any cables already in the manhole or blocking any spare duct.

After the splice has been completed, the cable should be carefully placed in proper position on the walls of the manhole and supported by cable racks.

Splices should be protected so that drippings from the street or moisture from the roofs of manholes will not get on the splice.

A brass tag, stamped with the cable number, should be securely attached to each cable in the manhole. The tags should be placed on the cables at a point where they are easy of access and can be readily seen. All tags should be placed in the same relative position on all cables in the same manhole.

MATERIAL.

The following material will be required for each splice:

A. Paper sleeves, or their approved equivalent, for covering the joint of each conductor.

B. Good commercial paraffine for boiling out the splice.

C. Strips of muslin, or its approved equivalent, for wrapping the splice.

D. Lead sleeve for covering the splice.

E. Solder for seams and wiped joints.

F. Gummed paper for limiting the wiped joint.

Paper Sleeves.—The paper sleeves should be made from a good quality of tough paper. The paper should

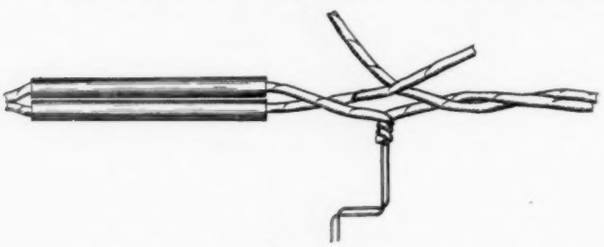


Fig. 3.

form a cylindrical tube consisting of at least two thicknesses of paper thoroughly adhering together. The inside diameter of the sleeves should be such as to permit their being readily slipped over the twisted joint in the wires and they should be of sufficient length to cover the joint properly.

Before using, the paper sleeves should be immersed in hot paraffine, or otherwise thoroughly dried, until they are entirely free from moisture.

Lead Sleeves.—Lead sleeves should be of the material of which the cable sheaths are made or of pure lead, and should have a thickness of walls of one-eighth of an inch. Where the manholes are congested, as is sometimes the case in large cities, sleeves of greater mechanical strength may be desirable. In such cases sleeves having a thickness of walls of three-sixteenths of an inch may be preferable.

GENERAL DIRECTIONS.

So far as possible splices should be finished and soldered the day they are begun. Where absolutely necessary, if the surroundings be dry, an unfinished splice may be left open over night, provided it be carefully wrapped and protected from moisture by a rubber blanket or other suitable covering. In wet or damp surroundings, however, work on a splice should be continuous until finished. In such cases the splice should be "boiled out" with paraffine at intervals—say after each fifty pairs have been connected.

Whenever it may be necessary to leave a cable end, it should be thoroughly dried and sealed with solder, as much care being taken as if the joint were to be permanent.

Expulsion of Moisture.—If it is suspected that moisture has entered the end of a cable, a short length of it should be cut off and dipped in hot paraffine when the presence of moisture will be indicated by a characteristic frying sound. If there is room to spare, the cable should be cut back, a short length at a time, until it gives no evidence of dampness.

After this the end should be thoroughly dried with paraffine and a splice made or the end sealed as already described.

Record of Splices.—A record should be kept of all splices with the name of the splicer and any items of interest. Each splicer should be held personally responsible for any faults which may develop in his work due to defective workmanship.

Making the Splice.—The operations in making a splice in their sequence, are as follows:

STRAIGHT SPLICE.

1. The lead sheath should be removed from the ends of the cables to be spliced for a distance equal to the length of the lead sleeve to be used in covering the splice. In removing the sheath care must be taken not to injure the insulation of the wires.

2. The core should be tightly bound with strips of muslin, or its approved equivalent, at the end of the cable sheath, packing the binding close to the sheath. This is done to prevent the wires from being cut on the edge of the sheath.

3. In general, as soon as possible after the removal of the lead sheath the exposed conductors should be thoroughly "boiled out" by pouring hot paraffine over them until all traces of moisture are removed. The binding must be saturated with paraffine as well as the core. Enough paraffine remains in the core to form a seal, which protects the cable against moisture, while the splice is being made. The temperature of the paraffine should be above that of boiling water, but must not be high enough to scorch or make brittle the paper insulation.

In drying or "boiling out" a splice with paraffine, always work away from the cable sheath towards the end of the conductors or middle of the splice in order to prevent any moisture being driven under the sheath. The paraffine should be poured on with a ladle. The paraffine draining off may be caught in the melting pot or a pan.

4. The ends of the cable sheaths and of the lead sleeve should be scraped bright for three or four inches and rubbed with tallow, or its approved equivalent, to keep them clean during the subsequent work on the splice. The tallow also acts as a flux in making the wiped joints.

5. The lead sleeve should next be slipped over the end of one cable, and moved back out of the way.

6. The two cables should be placed, and firmly secured, in the same straight line with the distance between the ends of the sheaths about three inches less than the length of the lead sleeve.

7. After the cables are in position the conductors

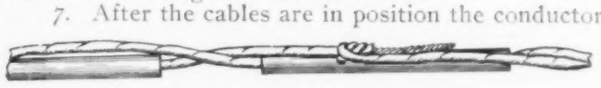


Fig. 4.

should be bent at the sheath out of the way and should then be spliced in the following manner:

8. Starting at the center or the lower back side of the cables a pair of wires from each cable is loosely brought together with a partial twist (Figure 1), thus marking by the bend in the pairs the point at which the joint is to be made. Slip on a paper sleeve over each wire of one pair and push the sleeves back far enough to allow room for making the joint.

The wires are now to be connected with a splicer's ordinary twist joint (Figure 2). The like wires of the two pairs to be spliced should be brought together at the point marked by the bend and given two or three twists (Figure 3). Remove the insulation of both wires beyond the twist, being careful not to nick or

scrape the conductors. The wires are now to be bent as shown and twisted together as if turning a crank. The ends should be cut off so as to leave the twist of bare wires not less than one inch in length. The twist should be bent down along the insulated wire and the paper sleeve slipped over the joint (Figure 4). The completed joint with the sleeves in place is shown in Figure 5.

In splicing conductors of unequal sizes the wires may be joined by means of a Western Telegraph joint, or other approved method, and soldered. The joint should be covered with a paper sleeve.

In splicing large gauge conductors the twisted wires should be cut at right angles to avoid any sharp points or burrs which might pierce the sleeve. Such points or burrs should be flattened with pliers.

In splicing, care should be taken to splice the center and lower pairs first, forming the outer pairs about the center pairs so that the finished splice may have a uniform shape.

In picking out the pairs to be spliced together, care should be taken to transpose the circuits thoroughly. It is sufficient if the transposing is done between pairs in the corresponding layers of the two cables.

The wire joints should be distributed along the whole length of the splice in order to keep the splice uniform in size and shape.

9. When all the wire joints have been made the splice should be again "boiled out" with hot paraffine until all traces of moisture have been removed. In applying this paraffine, work from the ends of the splice towards the middle.

10. The splice should then be wrapped with strips of muslin, or its approved equivalent, and compressed until the lead sleeve will just slip over the splice. Care must be taken not to compress the splice too tightly or the wires may be forced through the insulation and crosses in the splice result.

The splice should be dried out with hot paraffine after the first wrapping of muslin has been put on, and again after the wrapping of the splice is complete. The drying out should be continued until bubbles cease to appear on the splice.

11. The lead sleeve should be slipped into place before the splice has had time to cool, taking care, however, to see that the sleeve is perfectly dry.

The ends of the sleeve, which should overlap the cable sheath at each end by about one and one-half inches, should be beaten down to conform to the cable sheath and a wiped joint carefully made at each end. In making the wiped joints strips of gummed paper may be used to limit the joints.

Wiped joints should be carefully inspected, using a mirror when necessary, to detect any imperfections in the seal.

THREE-WAY OR "Y" SPLICES.

The method of making a three-way or "Y" splice is the same as for a straight splice except in the following particulars:

1. Where the cables all end at the splice.

2. Where a branch cable is to be spliced into a continuous cable.

In the first case the method is generally similar to a straight splice. The sheaths of all three cables are removed for a length equal to the length of the lead sleeve. The two cables forming the main cable are secured in a straight line with the distance between the ends of the sheaths about three inches less than the length of the sleeve. The branch cable should be lashed beside one of the main cables with the end of its sheath opposite the end of the sheath of the main cable.

The joint should be made by twisting together

Fig. 5.

like wires of pairs from each of the three cables, taking care to include two or three twists of the insulation in the joint in the manner hereinbefore described for straight splices.

The lead sleeve in this case may be a whole sleeve. It should be slipped on and pushed back on that portion of the main cable away from the branch.

In the second case a split lead sleeve must be used unless a sleeve has previously been slipped over the cable.

The sheath of the main cable should be removed for a length of about three inches less than the length of the sleeve. The sheath should be removed from the end of the branch cable for an equal distance.

The branch cable should be lashed to the main cable with the end of the sheath opposite the end of the sheath of the cable.

A pair of conductors in the main cable is cut. To one end of each conductor should be spliced a short piece of bare wire of the same size as the cable conductors. This wire should be twisted into the insulation two or three times in order to prevent its pulling back on the conductors. The second end of the main conductor, the free end of the bare wire and a like conductor of a pair in the branch cable should be twisted together, in the manner already described,

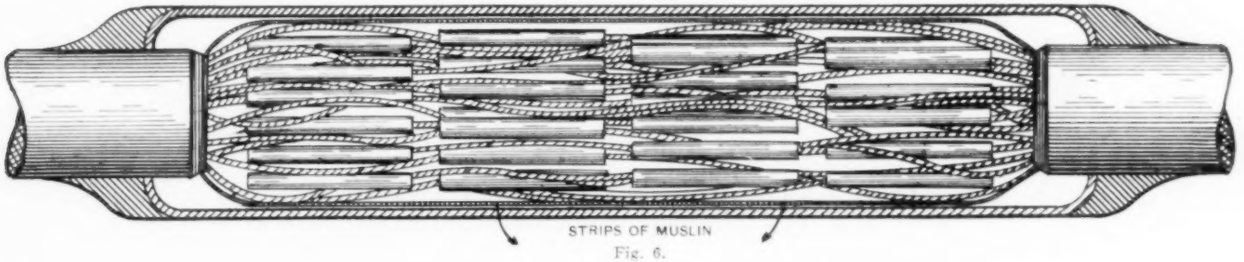


Fig. 6.

and covered with a paper sleeve which should be long enough to cover both ends of the bare wire.

If there is slack enough in the main cable the joint may be made without splicing in the bare wires.

In putting on a split lead sleeve the seam must be carefully soldered, then the ends beaten down to conform to the sheathes of the cables and soldered with

wiped joints in each end. Care should be taken to retouch the ends of the seam after the wiping is complete, in order to make sure that the seam has not been opened while the wiping was in progress.

Detecting Defective Pairs.—All sections of cable that are to be spliced together should be tested for defective pairs. New cable, as a general rule, is tested at the factory and defective pairs, if any, are marked at both ends of the cable.

Disposition of Defective Pairs.—In handling the work of clearing defective conductors a great deal of judgment must be used on the part of those having charge of this work. It is not good practice to open splices to clear trouble on one or two conductors, unless the cable is congested and the clearing of the conductors will postpone the work of providing relief for a considerable time. More damage is apt to be done to the cable than the clearing of the conductors warrants; in addition, the expense for labor and material, especially on a short cable, may amount to more than the actual value of the conductors made good.

While the disposition of any defective pair depends upon conditions, in general the following rules should be applied:

Conductors which are grounded, crossed or short-circuited in a house, block or branch cable, which it is not economical to clear, should be left open at the feeder cable splice; but conductors which are open should be spliced at the feeder cable splice. A record should be kept of such cases and forwarded to the office for future reference.

When splicing two parts together, of which one side of each pair is defective, the good wires of each pair should be spliced together.

If it is not economical to clear the defective conductors, the defective pairs should be spliced together. In case there are more defective pairs in one direction than in the other the extra defective pairs should be spliced to good wires, unless there is an opportunity of using the good pairs at a point between the splice and the central office, in which case the extra defective pairs should be left open in the splice.

The defective pairs in adjacent sections of cable should always be spliced together with the exceptions mentioned above.

The total number of defective pairs in a cable, when spliced, should not exceed the number in the section having the greatest number of defective pairs.

PHYSICAL INSPECTION AND TESTS FOR INSULATION RESISTANCE.

Under this heading are included both new installations and large additions to the existing cable plant.

Physical Inspection.—After the installation of a cable has been completed the work should be carefully inspected by the foreman for imperfections in workmanship and any defective conditions that might lead to cable trouble at some future time. The cable splicers should be required to inspect all the cables in a manhole, after they have finished their cable splicing. The cables should be inspected carefully for broken joints, cracked sheaths, improper racking and any other unfavorable conditions that might lead to cable trouble at some future time. The cable splicers should make any necessary repairs not involving much extra time or expense. They should turn in a report showing what repairs were made and if any further work should be done in the manhole to put the cables in good condition.

Test of Insulation Resistance.—The insulation resistance of a cable when spliced and connected to all its terminals should, if the workmanship is good, be at least 500 megohms per mile. A galvanometer test should be made to ascertain if the cables meet this requirement.

In making the insulation test precautions must be taken to insure that the terminals are clean and free from dust and moisture or the results of the test will be misleading as to the insulation resistance of the cable.

Low insulation resistance will be an indication either of injury done to the cable while being installed or insufficient boiling out of the splices. In wholly new installations of cable it is good practice to adhere to the minimum insulation resistance requirement of 500 megohms per mile. When the insulation resistance of a cable is found to be less than 500 megohms per mile, the trouble should be investigated and the insulation raised to the required amount. When low insulation resistance occurs, where changes and additions have been made to the existing cable plant, this requirement may be modified somewhat. Each of these latter cases should be considered separately, it being a question as to whether the expense of locating and clearing the fault is justified in order to meet the requirement of 500 megohms per mile.

It is sometimes desirable, when splicing long cables, to make an insulation resistance test at intervals during the installation. It is also desirable to make frequent insulation resistance tests when the splicing is done under favorable conditions such as wet weather and damp manholes. The tests should be made as often as the foreman thinks it is necessary to insure the required insulation resistance of the cable.

In making the insulation resistance test, it will not be necessary to test all the conductors in a cable. A test of a portion of the conductors scattered throughout the cable will as a general rule be sufficient.

Even with the utmost care and under the best of conditions such as are insured by the employment of skilled labor and the highest grade of materials, faults in cable splices will occur. It is felt, however, that with the employment of skilled labor and the proper supervision to insure that the methods outlined in these notes are carried out, the occurrence of these faults will be reduced to a minimum.

Power Used in Telephone Systems

Information with regard to the service of the New York Telephone Company indicates that the handling of a million messages requires on an average the expenditure of electrical energy to the extent of 900 kilowatt hours. Assuming a heating power of 13,900 British thermal units, it may be calculated that the development of 900 kilowatt hours requires 2,025 pounds of coal. Allowing for sundry power-house wastes, perhaps it would be permissible to consider an English ton as the amount actually required in practice. The telephone messages of the United States now aggregate 9,000 millions per year, so we may set down the coal required for transmission at 9,000 tons. Of course, this is only a small fraction of the tonnage required for heating purposes in the 50,000 telephone exchanges.

Special Service in Detroit

By J. J. Winthrop

VARIOUS forms of special service, quite out of the ordinary, which have been rendered by different telephone companies to their patrons, such as conducting a general information bureau, furnishing baseball and election returns, maintaining a morning call service and numerous other things, have been brought to notice from time to time; but the theatrical ticket bureau conducted by the Home Telephone Company of Detroit, Michigan, is one of the most unique.

Operators for the Theatrical Ticket Bureau, Home Telephone Company, Detroit.

Owing to the fact that Detroit is quite a theater city for its size and also to the fact that many patrons had formed the habit of ordering their tickets by telephone, the company found itself unable to render this service satisfactorily and was compelled to eliminate the taking of orders during a rush at the box office; the box office attendants at such times taking down the receivers, and, of course, the patrons received the busy signal in response to their call.

In order to overcome this condition the Home Telephone Company rented an additional office and equipped it with a specially designed order receiving system, carrying a large number of trunk lines and so arranged that the attendants could, at will, answer every call in the order of its receipt, thus eliminating the busy signal.

To avoid the necessity of additional work on the part of the various box office attendants an envelope order system was devised, each envelope being provided with an attachable flap, carrying a duplicate of the order. This flap is properly o. k'd by the box office attendant, detached and returned to the ticket bureau as a check upon the theater receipting same. The orders are delivered by messenger boys who are dressed in khaki uniform in order that they may be readily recognized by the employees of the theater.

What are known as limited reservations may be made by any patron of the company. These provide for holding the seats so reserved until 1:30 for matinees and 7:30 for evening performances. If not called for by the time specified the slips are removed from the envelopes and the seats sold to the first comers. Guaranteed reservations can be made only by such patrons of the company as have arranged for same beforehand and are held until called for, the patron paying for them when he calls. If he should fail to call, however, the company reimburses the theater the following day and looks to the subscriber for its compensation. The guaranteed reservation saves the patron the necessity of calling for his ticket at a certain hour and he thus avoids the delay which ensues between that time and the time the performance begins. He is also able to reserve seats after 7:30 in the evening, providing any remain unsold, a privilege not extended in connection with the limited reservations.

The system was started originally for the benefit of Detroit patrons, but it has been extended to include Ann Arbor, Ypsilanti, Wyandotte, Trenton, Grosse Isle, Northville and Plymouth and so popular has the service become that on one occasion the bureau reserved 630 seats out of a total of perhaps 3,500 scattered among the principal theaters of the city.

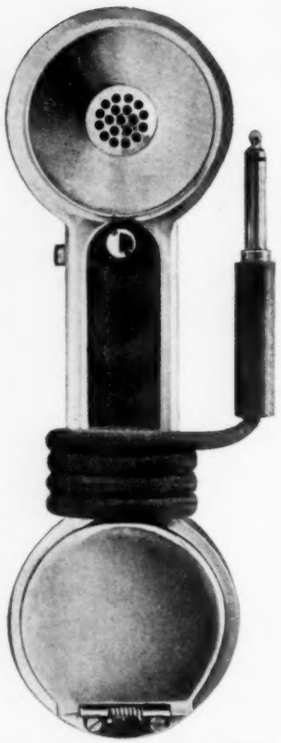
Another unique departure from the usual routine of telephone operation, and one which has almost endless possibilities, is the "wayside service" conducted by the same company.

The service comprises a number of public connecting stations located five blocks apart throughout the city and on the main roads leading out of the city in all directions, the distribution being so arranged that no subscriber will be more than two and one-half blocks in any direction from one of these stations.

These stations each consist of a cast iron box, containing a specially designed jack which connects directly with the wayside circuit. The box itself, which is almost square in shape, is mounted behind a ten-inch cast iron shield, painted in three colors—red, white and blue; and bears the words "Home Telephone Wayside Service." These stations are attached to poles and buildings six feet from the ground and are located at street intersections. Their construction is such as to render them almost indestructible and it is almost impossible to put them out of order. The

subscriber is supplied with a novel pocket directory which shows the location of each station. For a nominal rental subscribers to this service are furnished with a portable telephone or microphone—the lightest and most compact ever made—and while it is so small that it can be carried in the pocket without the slightest inconvenience, yet it is so strong that nothing short of a malicious attempt to destroy it will in any way affect its efficiency.

The instrument is furnished with a cord which terminates in a key plug of new design and the instant this plug is inserted into the keyhole which appears in the jack box, in the center of the shield heretofore mentioned, the line signal on the switchboard at the central office brings the operator in on the line and the entire exchange is at the subscriber's disposal.



Instrument for Wayside Service.

It is difficult to over-estimate the value of this wayside service, especially in cases of emergency as it saves the trouble in localities where there are no public telephones, and it saves the time required to locate one in sections where there is such service.

As Detroit's fame as a baseball center is world-wide any telephone company that did not in some way lend its service to boost the game could hardly be considered loyal to its own city.

Realizing this fact, the Home Telephone Company, at the beginning of the 1909 baseball season, decided upon furnishing its subscribers with prompt and accurate returns of all games, both at home and abroad, by innings and half innings and for this purpose established a base ball information department which was in the hands of twenty operators who were specially trained not only in the handling of the apparatus, but also in the mysteries of the game. As a result during the entire season from 12,000 to 20,000 inquiries were handled each day and in such manner as not to affect the regular exchange service. On April 14, the opening day for the present season, over 20,000 inquiries were successfully handled and the service will be continued throughout the season.

This service is furnished without extra charge to all subscribers who are under contract with the company for unlimited exchange service.

Hydro-Electric Phenomena

The *Post Office Electrical Engineers' Journal* gives an account of the electrostatic charging of telegraph wires by locomotives which occurred at Dell railway-crossing station on the Natal-Transvaal main line. The occurrence is described as exceptional, even in a country where extraordinary atmospherical effects are not unusual; but The *National Telephone Journal*, London, quotes an account of similar phenomena (in connection with a stationary colliery engine and telephone wires) given by Mr. Gill eight years ago in a paper read before the Dublin section of the Institution of Electrical Engineers:

In June last (1902) one of the employees of the National Telephone Company was working on a pole supporting a number of wires (seventeen) running through a rural district near Glasgow. On touching the topmost wire the man received a severe electric shock. On reporting the matter to a member of the Engineer-in-Chief's staff, Mr. Watts, the matter was investigated, and it was found that during certain times sparks could be drawn from the wire in question. This wire was found to be an unused one and was of copper weighing 100 lbs. per mile, about 1,000 yards long, and insulated at both ends and over its whole length. It was carried at a height of 26 feet from the ground, and its capacity would be about .0087 mfd.

It was at first difficult to explain the reason for the charge as the wire seemed perfectly insulated from all other conductors. The only thing at all unusual about the line was found to be at a point where the exhaust steam from a colliery engine was blown from a distance of about twenty-three feet by the wind against the wires. The exhaust pipe extended vertically eighteen feet and was three inches diameter at the top. It was found that the charge only accurred when the engine was working on load, and only when the wind blew the exhaust steam against the wire. Further investigation was made by Mr. Watts, who had a collector constructed of a long bamboo rod with an insulator at the top on which was fixed a number of short pieces of wire with a rubber-covered wire connected at a lead to the ground. When this collector was held in the steam near the mouth of the iron exhaust pipe a series of sparks was obtaind from the covered lead, and the origin of the charge completely located. The weather during these experiments was exceptionally dry, and the charge could not be obtained on damp days.

Since that date Professor Magnus Maclean of Glasgow, having had his attention drawn to the phenomenon by Mr. Valentine, the company's district manager, has conducted some experiments by means of a portable electrometer. He found that when a similar collector to that already mentioned, but with the lead wire terminating above the ground, was inserted near the steam, continuous sparks of one-half inch to three-fourths inch long could be obtained between the end of the lead and a metal rod driven into the ground, the best results being obtained when the pressure of the escaping steam was highest. This length of spark would indicate a potential difference of about 40,000 volts. Professor Maclean also took sparks from the lead through his body and noticed that the physical pain experienced was much more severe than from a spark due to about 100,000 volts pressure derived from a large 24-plate Wimshurst machine.

Professor Maclean also tested the potential of the air six feet above the ground and found when under the issuing steam and about twelve feet from it some 1,100 volts, and at a point thirty feet from the steam about 900 volts, when the engine was working. The electricity generated was positive in each case. Of course, the hydro-electric effect of steam under pressure is well known and has been investigated by Faraday and by Armstrong, but it is very seldom that the effects are seen in the natural order of things.

The longest spark in the Natal instance had a value in kilovolts of 14.3. It will be seen that those referred to by Mr. Gill reached 40.

The Status of the Operators

Are telephone operators clerks or mechanics?

That is the vexed question which Labor Commissioner Maupin, and the telephone companies of Nebraska have put up to Attorney General Thompson, and while it remains undetermined it is certain that the Douglas county grand jury will not be asked to inquire into whether the Nebraska Telephone Company is violating the law governing the number of hours women employes shall work.

If they are clerks, their present hours of employment do not conflict with the laws of Nebraska made and provided. If they are mechanics their hours are too long, according to Commissioner Maupin.

What One Woman Thinks

By Sarah Elizabeth Brown

I HAVE heard from the Continental Company. Got some actual details. You will remember that I've been nearly crazy about the Continental ever since it started. When I hear of an independent organization of $50,000,000 it is only natural that I would care to know what it is planning to do and how it will do it. But now its all spread out in the papers under the guise of a friendly receivership proceeding. I will have to be made over to understand this friendly receivership business. If Obediah and Ben Phelps ever got into a row, a receivership would be almost the last means they would adopt to settle their dispute. Receiverships and stability don't trot in the same class. It may be all right, measured by some freak financial standard, but a $50,000,000 independent telephone concern in receivership doesn't sound good to the rest of us independents who may have need for some money to promote our own enterprises.

The papers have also dug up some interesting side lights on John A. Howard, president of the Continental, slated for retirement. It seems that John was a glass-blower only a little while ago. The only glass-blowers I ever saw had flabby cheeks and bleary eyes, but that may have nothing to do with their blowing in other ways or seeing things from a bad angle. Any way, they say John worked in a glass foundry and then blew into politics before he became a telephone magnate. He started penniless and is now reputed to be worth a million. He is somebody to be reckoned with. Among the other things about John that sound good in print is his association with other millionaries, notably Frank Gould.

The charge preferred against the Continental Company was insolvency. Terrible thought—fifty millions of dollars and not a cent for circuits. Bernard M. Wolf of Boston, one of the biggest retail clothing merchants of Beantown made the application, and away off here, it seems funny that a big financial man of Boston would be flirting with anything but Bell securities. From what I have been told, the old Hub city has been raked with a fine-toothed comb by and for the Bell. Obediah says this man Wolf should have been left out on suspicion, but that's just like a man.

It is claimed that Max Koehler of St. Louis and John Howard of Wheeling couldn't get along together; Koehler charging that Howard was a bad manager. It is most unfortunate for independent telephony. If we were all familiar with gentlemen's agreements and the finer ethics of friendly receiverships this incident would probably make no difference, but unfortunately we aint. It sounds like a bad mess and I'm thinking that a re-organization will have to come out into the open and show, if it expects the full confidence of independents and hopes to do business with them. A nice, large parallel and competing long-distance system is what we want, but it will mean business for somebody and somebody will have to mean business to tackle it.

* * *

This Continental affair has dragged Jim Brailey back into the limelight. It seems that Brailey was in cahoots with Wheeler and Stifel and Koehler. The U. S. lines in Ohio would put a few tentacles on the baby octopus and Brailey was the boy to do the business. There is a story that $12,000,000 of foreign capital was to filter into the Continental and the thought of that idle pile of strange money stirred up the circulation of all the independent promoters, including the glass-blower. Even Latzke—the man unafraid—got the infection and promised 64 pages a week. He made a great splash when he hit the pond, but the mark was too high for the bunch who are backing the Wall street sheet. Somehow blue doesn't go well in independent telephony, no matter how its applied. And Wall street always will sound bad to most independents.

Well, you know what they did to Brailey, don't you? The Continental's chance of getting across Ohio will depend upon securing that foreign money and spending it in the regular way. Independent companies in Ohio are busy with a legitimate business of their own. They seem to be pretty well connected up to take care of their subscribers. They are spending money and improving plant, the which sounds good to me.

* * *

The National Independent Telephone Association is busy these fine corn-growing days in an effort to railroad the Railroad Bill through congress. They want the telephone companies that do interstate business placed under the supervision and control of the Interstate Commerce Commission. It looks like this will be done and I hope it will work out all right for those independents whose systems have reached beyond state lines. The only argument that has been offered against the measure is that the commission has its hands full already, but there is always room for some extra desks in governmental offices and I'm sure there are some mighty good men who are waiting for nice governmental jobs. I see that Willis Abbot is boosting for the independents in his little syndicate corner and he is saying pert little things that bring joy to my heart. Abbot always was a rooter for the common people. He broke into the old Farmers' Alliance when it was started and I used to read his stuff in the *Farmers' Voice* before I ever saw a telephone. The Railroad Bill may never affect our little system, but if it will help some of my brothers in a common cause, I'm hoping that congress will pass the measure. The telephone hasn't had a great deal of national legislation and a little of it will add some dignity to us, if nothing else.

* * *

A new farmers' telephone company has been formed by J. Peplinski, L. Prokopobitz and F. Ranisjewski. No, dearest Vivian, this is not a foreign corporation—headquarters Pulaski.

* * *

Jim Kelsey is surely enjoying himself by defending the rights of minority stockholders. There is one thing that Jim seems to forget in treating the Bell company with a weekly broadside of grape and canister, for he is forever quoting scripture and pointing a moral.

When the Good Book was written there were no corporations. That is the point Kelsey overlooks. The Bible deals with men. Men have souls in spite of themselves. They have conscience. Corporations have neither soul or conscience. You can talk to a man. You can tell him where he gets off. If he is a real man, he may resent some of the things you say, but a corporation doesn't care.

Investors should know all about corporations by now, for they are pretty much alike. According to Jim Kelsey, the Bell company is hard-hearted, cantankerous and selfish. It is a despoiler now as it was years ago and it isn't going to reform. It begs for the savings of the widow and the orphan and wots not.

Like Bosko, it eats 'em alive. I am sure that Kelsey believes in patriotic, unselfish, honest and decent citizenship. He should have lived with Isaiah who said: "And a man shall be as a hiding place from the wind, and a covert from the tempest; as rivers of water in a dry place; as the shadow of a great rock in a weary land."

This would be a grand old world if corporations would slow down a little in the game of grab and deal justly with men who make them possible. A minority stockholder is such from choice. If he puts money into a venture it is his funeral. We live in the now of things and it is our own fault if we make our bed in a thorn bush.

Moral: Get a little octopup of your own and tote fair. Print the xxxii chapter of Isaiah on your stock certificates and be "a hiding place from the wind."

* * *

Who is H. N. Casson? Listen to this song he sings in the *World's Work:*

> The "grand telephonic system" which had no existence thirty years ago except in the imagination of Theodore N. Vail, seems to be on hand. There is nothing mysterious and ominous in it. It has nothing to do with the pools and conspiracies of Wall Street. No one will be squeezed out save promoters of "paper companies." The system of the future will be national, that any two people in the same country may be able to talk wit heach other. It will not be competitive; it will have a staff-and-line organization. Each local company will handle its own affairs; but there will also be, as now, a central body of experts who will handle the larger affairs common to all compies.

Talk about your "bunk talk!" It may not be just the proper thing, but my notion of physical connection of all lines was set down on pages 135-6, Telephone Engineer, October 1909. When this paper said "Unity of system does not mean monopoly of control," it was laying down, in very few words, a platform that should be accepted by all independents with the proper quota of vertebra in their spinal columns. Who, then, is this H. N. Casson who says that the system of the future "will not be competitive?" Pooh-pooh, for him!

* * *

TELEPHONE SUITS DISMISSED.

Another step in the merger of the Bell and independent telephone interests in this state has just been taken in Cleveland when the suits between the rival telephone companies was dismissed without a hearing by Judge R. W. Taylor of the Federal circuit court. Judge Taylor heard the arguments on the demurrers of the defendants, the Central Union Company and the American Telegraph and Telephone Company, and sustained them. The complainant, the United States Telephone Company, which was the independents' long distance line, did not desire to plead further and the court dismissed the bill at complainant's costs.

This settles the much discussed telephone suits which were brought in Toledo over a year ago by the Bell to break up the 99-year agreements made by the independents' long distance line with the independent exchanges throughout the middle west. As the Bell bought out the independents there was no further necessity for a lawsuit, and the action of Judge Taylor virtually closes the big phone war.—*Toledo* (O.) *Bee.*

Well, well! I thought Morgan owned this property.

* * *

One of the chief pleasures of being a parent is to watch the children grow—to observe the changes in them—to make comparisons. If everything is fair in love and war, let us talk of love, for very few of us know about war, any way. This is the month of June—the season of billing and cooing. Even the parents grow reminiscent. I was a girl myself once, a long time ago. I recall Obediah's courting and when it comes back to me, I can't see that young America has made any advances. Minnie's beau may have a likelier turn out—a more comfortable buggy with its newest frills in upholstery and rubber tires, but he goes about his business in the good old-fashioned way. Love's vocabulary hasn't altered in a hundred years. The furnishings in our home may be more modern, but I have noticed that the big couch comes in for its full share of use. I think that there has been no improvement in gallantry—no new thing in lovers' affairs. The which said brings me up to the jiggle of the Phelps County Telephone Company with headquarters at Holdrege, Nebraska. When I hear of an independent company buying out the Bell company I tuck it away in my memory. The Phelps company bought the Bell company in Holdrege a few years ago. It has now been sold to the Bell and becomes a portion of the system of the Nebraska Telephone Company. It is like love's old conquest. If there isn't one way to get her, there is another.

Census Report on Telephones

According to a report being issued by the Census Bureau on the 1907 census of the physical equipment, service and financial operations of telephone companies, the total number of systems and lines is 22,971 and the miles of wire is almost 13,000,000. The number of employees is 144,169 and the salaries amount to over sixty-eight million dollars. The capital stock and funded debt was $12,316,109.

Compared with the census of 1902 the report shows an increase of 151 per cent in systems, 165 per cent in miles of wire, 83 per cent in employees, 85.6 per cent in wages, 134 per cent in capital stock and 112 per cent in income.

The greatest amount of increase in wire mileage, telephones and business between 1902 and 1907 is shown in the North Atlantic and North Central states where the industry is largely concentrated.

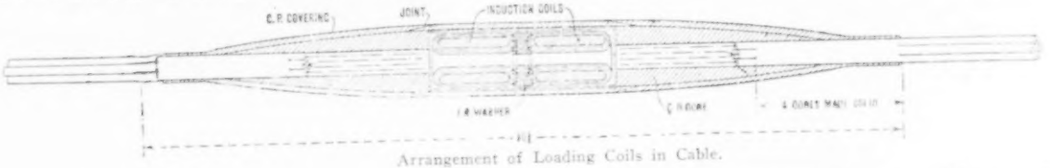
More rapid rates of increase, however, occurred in other sections, the largest percentages of gain for wire mileage being shown for the Western, South Central and South Atlantic states, due no doubt to the fact that as a rule telephones in these sections are farther apart than in the other divisions. The largest percentages of increase also in the number of telephones and talks is in the western states.

The number of telephones is regarded as probably the most satisfactory measurement by which to determine the relative importance of different companies. The independents owned 44.4 per cent of the total number of telephones in 1902 and 48.8 per cent in 1907.

The Anglo-French Loaded Cable

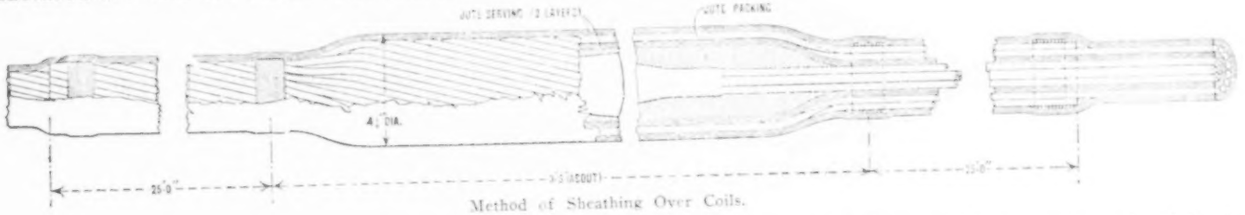
By R. White Lindsay

A NEW telephone cable has been laid between England and France supplementing those now giving service between London and Paris. As a result of negotiations between the two countries, it was finally decided to lay two new cables, each containing four wires (two circuits), one to be laid by each government. While the French cable resembles more or less the type already in use, the British one embodies the most recent improvement in the design of long distance telephone lines, namely, the insertion of loading coils at intervals along its length. Its scope is not limited to conversations between London and Paris, but it has been so designed as to make it possible to converse through it between Paris and all the large towns in the Midlands and north of England, and even to Glasgow, by making use of the existing lines. The tests to which the cable has been subjected show that the electric properties contemplated by the designers have been accurately filled, and it is reasonable to expect that the extension of telephone service to the north will be rapidly carried out as soon as the necessary traffic arrangements can be completed by the authorities.



Arrangement of Loading Coils in Cable.

This installation is unique in that it is the first submarine cable in which loading, or inductance, coils are distributed throughout its length on the Heaviside-Pupin principle, the outcome of the experiments of W. Dieselhorst, manager of the Messrs. Siemens Bros. and Company's cable works, Woolwich, who manufactured and laid the cable. Mr. Dieselhorst laid the lead-covered cable with loaded coils in Lake Constance in 1906, at which time he realized the difficulty that would be experienced in dealing with lead-covered cable in submarine work, owing to its great weight, and the damage which would be caused to a lead cable in tidal waters. He at once began experiments by inserting loading coils in gutta-percha-covered cables and as a result in 1906 he succeeded in securing a patent on a method of doing this, which in a slightly modified form is the same as that in use in the new Anglo-French cable. An experimental cable made in this way at the Woolwich works was left in water for fifteen months and occasionally during this time it was subjected to a pressure of four tons per square inch, equal to a depth of 2,500 fathoms of water, and was found to stand the tests without injury. As a result of these tests Messrs. Siemens Brothers and Company, when tenders were invited for a loaded cable for laying across the English channel, were able to guarantee a standard cable equivalent length of 3.5 miles for the total length of 21 nauts (24.2 miles) and their tender was accepted. Later tests, however, have proven that the actual cable has a standard cable equivalent of 3.28 miles, which is still better than the guaranteed figure. Without loading coils, a mile of the same cable has a standard equivalent cable length of 0.435 mile, and therefore the actual gain due to the addition of loading coils is equivalent, in its effect on the speech transmitted, to reducing the length of the cable 3.2 times. The cable is a four-core cable with conductors weighing 160 pounds to the mile, insulated with 300 pounds (per mile) gutta-percha; the resistance of the conductors per loop mile is 12.5 ohms, and the wire-to-wire capacity 0.12 mf. per mile. The inductance coils, each of slightly less than 6 ohms resistance, with an inductance of 0.1 henry at 750 cycles per second, are placed at one naut (1.153 miles) apart. The actual attenuation constant of the cable is 0.140 per mile, while the cable without its inductance coils has an attenuation constant of 0.045 per mile. As the cable and coils were designed for an attenuation constant of 0.0147 after preliminary experiments had been made, the closeness to this figure is extremely satisfactory.

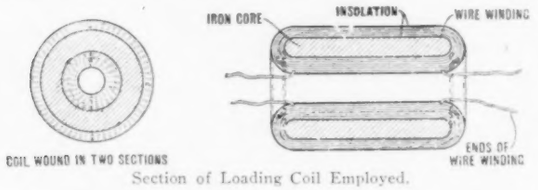


Method of Sheathing Over Coils.

As the mechanical problem connected with the insertion of loading coils in a submarine cable is even more important than the electrical one, the makers are to be congratulated on its solution, which has resulted in the coils having been inserted so compactly that the part of the cable containing them can be paid over a four-foot sheave without damage. The accompanying illustrations show the design of the coils and the method of inserting. The diameter of the gutta-percha core is increased by them from about one inch to three inches, a gutta-percha cone is inserted at each end as packing, and a gutta-percha sheet is wrapped round them and joined to the gutta-percha of the core at each end.

Some alteration has been made in the arrangements of the loading coils and instead of four coils, inserted one after the other, one for each of the four wires of the cable, two double coils are employed. Each double coil consists of two windings on the same iron core, and one winding is connected in series with each conductor. This arrangement has an advantage over four distinct coils, as the iron core experiences an aging effect which affects its permeability, and may not be precisely the same in two cores. If separate coils on separate iron cores were used for the going and return circuit, the gradual change in permeability might disturb the even balance of the circuit, but by winding them on the same core the variations are automatically compensated. There is a sheet of metal foil between the silk-covered wire of the coils and the gutta-percha sheet, which is not shown in the drawing; this was found to be a necessary precaution in the construction of the cable, and has been patented. In order to give greater flexibility an annular rubber distance-piece is inserted between the two sets of coils.

The method of armoring is extremely ingenious. The stranding-machine is stopped at about ten yards before the position of the coils is reached, and a second armoring started on the top of the other one. When the bulge in the cable is reached the wires of the second armoring, which is given the same lay as the first, automatically place themselves between



Section of Loading Coil Employed.

the other wires, so that the part of the cable with the increased diameter is covered with a single layer of the armoring wires, and at about ten yards on the other side of the coils the additional wires are cut and bound up as before.

This type of cable was chosen in the face of much criticism by continental experts. It has been generally regarded that on account of the high specific inductive capacity of gutta-percha a cable insulated with this material would not be suitable for loading with coils, and that the calculations employed in the design would therefore be falsified. It has been proven by the tests, however, that this is far from being the case and other tests made on continuously loaded cables show that the coil method of loading are very much more effective. The continuous loading consists of covering the copper conductor with a close spiral winding of thin iron wire throughout its length. It is very obvious that this cannot increase the inductance to the same extent as the insertion of coils at intervals, while at the same time it materially increases the capacity of the cable. Actual measurements against standard cable compared with the values calculated for the same cables as those under test, but without the continuous iron winding, showed that the improvement due to the continuous loading was about sixty per cent, while with coil loading an improvement of from 250 to 370 per cent has been shown to be practicable—the former by experiments with gutta-percha cables, and the latter with paper-insulated cables.

"Telefon-Hirmondi" in Chicago.

The Telephone Herald, an offshoot of the Telefon Hirmondi, an institution which has been in operation in Budapest, Hungary, for many years, threatens to invade Chicago. Patent rights have been purchased by an American corporation. The advance agent of the company is a Hungarian, Ladislaus de Doory, who is at the Kaiserhoff hotel. The president of the company is Manly M. Gillam and the secretary and treasurer William H. Alexander, both of New York City. The capital stock is given as $1,000,000, fully subscribed.

According to Mr. de Doory, Chicago is going to rise up and give the Telephone Herald such a welcome as it has not extended to any other enterprise that ever came into the city. He sees in the Telephone Herald not only a boon to lazy men, and busy men too, for that matter, and a blessing to housewives, but a household convenience that children will cry for and invalids praise from their sickbeds.

"For five cents a day," said Mr. de Doory, "we will put into the homes of Chicagoans an arrangement that will not only serve them from 8 in the morning until 11 at night with all the news of the world for the day just as quick as it comes into the city by wire, but we will give them a concert for luncheon, together with a resume of the day's news and all the gossip of the city. In the evening we will entertain the whole family with a concert—not a phonograph concert, mind you, but a real concert, just as it is sung or played downtown—and at night we will put them to sleep with popular selections or music of the great masters. Can you beat it? Why, within a year everybody in Chicago, from hod carriers to millionaires, will have the Telephone Herald in the house.

"But that isn't all. That is the bare skeleton of our program. Once or twice a week we propose to furnish lectures to subscribers. The woman of the house can sit down to her sewing and hear what some eminent speaker is saying to a body of club women—at Orchestra Hall, for instance. Between numbers we will let them know what the latest bargains are in the big department stores.

"We have also a special program for children, and I think that this will fill a long felt want with couples who are trying to bring up families of young children in flats so crowded that the youngsters drive their parents nearly insane trying to find something at which they can amuse themselves.

"However, the chief part of our business will be the megaphoning of news. Our idea is—and we have the facilities for carrying it out—to give our subscribers a resume of what the afternoon newspapers are carrying just as fast as the news happens. We will carry not only the regular market quotations, the racing news and the baseball results, but news of every character, from cyclones and earthquakes to the newest discoveries in stage stars and the latest styles in millinery. It will be possible with our facilities for a subscriber to sit in his home and hear a jury return its verdict in a big trial downtown."

The Independent Telephone Company of South Omaha, Neb., has accomplished the remarkable feat of erecting a two-story telephone exchange building, installing the automatic apparatus and laying several miles of underground cable in conduits in less than thirty days.

Telephone Engineering at the Golden Gate

By Arthur Bessey Smith*

THE telephone requirements of a large city differ in certain essential points from those of a city of small or moderate size. The chief of these are as follows:

Measured service, private branch exchange service and interborough service.

Although these exist to some extent in smaller places, they are peculiarly important considerations in the telephone service of a large and congested city. They are practically the conditions which had to be met by the automatic telephone exchanges installed in Oakland and San Francisco, Cal.

The interest in the region of the Golden Gate centers about two cities—San Francisco and Oakland. The former is a thriving seaport of about 350,000 inhabitants. It occupies the rough, hilly, northern end of the small peninsula (see Fig. 1) which separates the southern end of San Francisco bay from the Pacific ocean. The rather sandy region south of the city is thinly populated. The north peninsula across the Golden Gate is more thickly settled. To the eastward across the bay lies the city of Oakland, in the pleasant region between the Berkeley hills and the water. Oakland has a population of over 250,000, while Berkeley, Alameda and other smaller cities have about 60,000 inhabitants. The total population of the region reaches well up to three-quarters of a million.

The Problem Stated.—The requirements to be considered in designing a telephone system for this region may be briefly stated as follows:

1. A system which shall give satisfactory telephone transmission between all points in the whole territory.

Fig. 1. Map of San Francisco and Oakland.

2. A system which provides satisfactory accessory conditions such as ease, rapidity and accuracy of completing and controlling connections, methods of charging for service and means for discrimination in the same.

The consideration of these general requirements as applied to the case in hand causes their expansion into ten conditions, viz.:

1. Quiet, clear transmission over all talking circuits.
2. Easy, quick and accurate completion of local connections within each exchange district.
3. Provision for the cosmopolitan nature of the population especially regarding the diversity of languages.

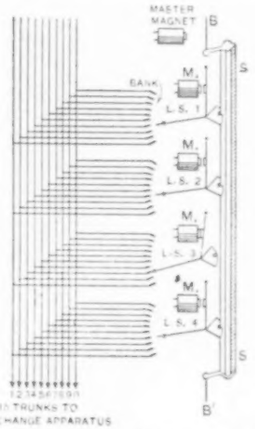


Fig. 2. Grouping of Line Switches.

4. Measured service.
5. Free service on calls to certain classes of stations.
6. Private branch exchange business.
7. Quick and accurate completion of calls between exchange districts, especially between San Francisco and Oakland.
8. Accuracy in charging the accounts of credit toll users.
9. Credit and cash toll work between exchanges.
10. Provision for the harmonious mutual working of different types of apparatus used in the several exchanges.

LOCAL EXCHANGE APPARATUS.

Oakland.—The locations of the offices in Oakland are shown in Fig. 1. More extended and detailed descriptions of local exchange apparatus have been given from time to time.** The means by which a subscriber controls the switches is briefly reviewed here to make clearer the operation of the special functions to be described later. The two-line wires which extend from any Oakland office to a subscriber's station are termed "vertical" and "rotary," respectively. In the office each is connected to a relay which has its other terminal attached to a battery of storage cells. The other (positive) terminal of the battery is grounded. The dial or calling device at the substation, when operated, grounds each wire in a definite way, operating the relays, and through them the switches.

The vertical wire is the impulse transmitting member, for over it are sent at various times the exact number of impulses required to set the switches according to the digit called. The rotary wire is the switching or circuit-changing member. It determines upon what switch or magnet the vertical impulses shall act. At the

*Abstract of paper read at the annual convention of the A. I. E. E., June 27, 1910.

**"Modern Automatic Telephone Apparatus," by W. Lee Campbell, Telephone Engineer, for March, 1910.

close of any series of impulses over the vertical wire, one impulse is always sent over the rotary wire to shift the connections in the switches so that the next series over the vertical line will be effective on the next operation to be performed.

When the called subscriber answers, a relay in the connector is operated which switches the rotary wire

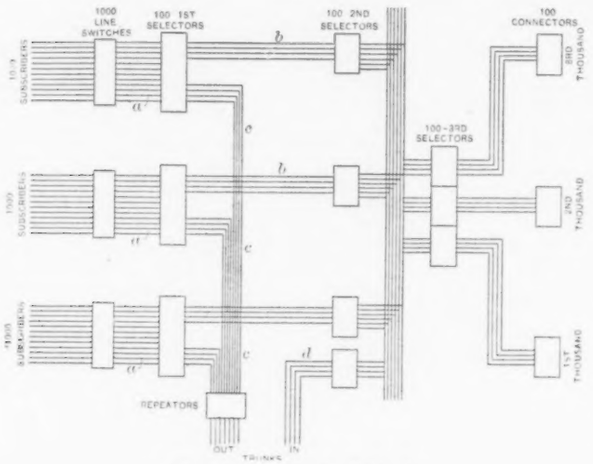


Fig. 3. Trunking in Oakland.

from negative to positive battery, thus supplying talking current to the calling subscriber.

The simultaneous grounding and clearing of both vertical and rotary lines causes the switches to be released and restored to normal position.

San Francisco.—The relative locations of the four offices are shown in Fig. 1. The grouping of switches is somewhat different from that of Oakland owing to the introduction of secondary line switches. A typical arrangement is shown in Fig. 4.

Each subscriber's line terminates in a primary line switch. These switches are grouped in units of 50 each, and have access to ten trunks, as in Oakland. But here the difference begins. The trunks from the primary line switches are carried to secondary line-switch units, where each trunk terminates in a secondary line switch. Each unit group of secondary line switches has access to a group of ten trunks, *d*, each of which ends in a first selector. The secondary line switches are exactly like the primary switches in function, for they pre-select the idle trunks in exactly the same way.

The exact method of operation differs radically from that used in Oakland, for the San Francisco apparatus is controlled by the subscriber over two wires with no earth return. This greatly simplifies the subscriber's telephone and gives many structural and operating advantages.

The two subscribers's line wires are known as positive and negative, indicating the terminal of the battery to which each is attached through the windings of the line relay. The series of impulses for stepping up the wipers of the switches is caused by the dial or calling device, which opens and closes a normally closed pair of contacts. The line relay follows these impulses and repeats them to the magnets which move the wiper shaft.

The switching of the circuit to the next switch or operation depends upon the time interval between one series of impulses and the next. During a series, the circuit-changing member is held by a catch, which is released when the impulses cease to come. The release is accomplished by simply opening the line circuit by hanging up the receiver. This momentarily brings into action the release magnets which restore all switches to normal.

Measured Service.—One of the conditions met in managing a telephone system in a large city is the desirability of charging for the service in proportion to the amount of service rendered. This is ordinarily done by attaching a meter to each subscriber's line. The requirements of a meter are as follows:

1. It must register only once for each completed connection, rejecting those in which the called station fails to answer.

2. It must make no charge for connection to certain classes of telephones, such as fire, police, information and complaint desks, etc.

The Oakland exchange is operated on the fiat rate basis for all calls originating and terminating within the exchange, which includes the suburb of Berkeley. In San Francisco measured service is required.

The meter in an automatic telephone system is attached to the line switch. As above mentioned, it must not operate until the called station answers. Therefore, the latter act must cause some change in electrical condition at the line switch which will cause the meter to register. The line switch of the calling station and the connector which picks up the called line may be in different offices with 1st, 2d and 3d selectors and a repeater in the circuit between. The called station can control the connector and through it the condition of the line leading back to the line switch. Two changes in condition are available, reversal of current and change of current strength. The latter is undesirable on account of its interfering with conversation to stations set aside for free service. The former seemingly necessitates some form of polarized magnet. As it was desired to avoid the use of permanent magnets, a two-coil meter was devised. It is so arranged that when the called station answers, the current supplied to the latter operates the relay which reverses the current supplied to the calling line. This causes the meter to record one call. Neither coil alone will cause registration, and the apparatus has a range from 0 to 1,500 ohms line resistance. Its line coil is of low resistance and is short-circuited during conversation. The reversal of current for operating the meter is accomplished in such a manner as not to cause inconveniences to the calling subscriber.

Free Service.—Since the connector is the switch in which occurs the reversal of current which operates the meter, the means for giving free service must affect this part of the apparatus. It is done by grouping all free service lines such as information, police, etc., into one or more hundred groups, each group served by a set of connectors. All these connectors are so wired that the current flow to the calling subscriber is not reversed when the called station answers, consequently no register is made.

There is one class of calls for which, strictly speaking, no charge should be made, and that is calls which result in the wrong number being obtained. The meter makes no discrimination here, and if the called station answers, a call will be recorded. However, experience has shown that such a small per cent of wrong numbers are obtained that they may safely be neglected. This is especially true if wrong calls due to carelessness in the use of the dial be omitted. For these it is right to ex-

pect the subscriber to pay. The same is true of regular manual practice, for if a subscriber calls for the wrong number and gets it, he is expected to pay for it.

Cash measured service is furnished by means of coin boxes attached to the line wires at the subscriber's stations. No coin is required to be deposited in order to call. When the called station answers, the reversal of current operates a magnet in the coin box which short circuits the transmitter and places a shunt in parallel with the receiver. This prevents the transmission of speech, but allows the user to hear faintly the voice of the called subscriber. By dropping a coin in the chute, the shunts are removed, so that conversation can take place.

When a call is made to a free station as above described, no reversal of current takes places, so that the calling subscriber is not forced to make a payment.

Private Branch Exchanges.—In both Oakland and San Francisco the nature of the business makes quite a large number of private branch exchanges profitable to the subscriber and to the operating company. These boards are manually operated and have several trunks connecting them with the nearest public exchange office. Each business house is listed under one number in the directory. When a public subscriber selects the call number the connector switch must automatically select an idle trunk to the private branch board. This is done by a special type of switch known as the rotary connector. It responds to the impulses for the tens and units digits of the call number, but immediately thereafter acts as a selector until an idle trunk is found. These rotary connectors are grouped in hundreds so that in providing for this special service the call numbers are set aside in blocks of one hundred

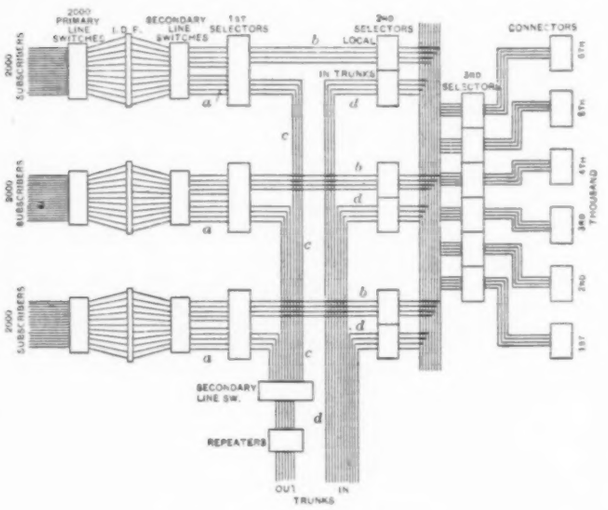


Fig. 4. Trunking in San Francisco.

each. Thus in the Main office, San Francisco, the 1100, 1200, 2100, 2200, 3100, 3200, 4100, and 4200 hundred units are set aside for private branch exchange service and no number in them assigned for individual lines.

Let us suppose that the call number of a certain wholesale house is C-4251 and that four trunks are required for the business. The connector switches in the 4200 group of the Main or C office will serve this board. These four trunks will be multiplied to the first four sets of contacts in the fourth level of the connector banks, that is, corresponding to numberss 4251, 4252, 4253, and 5254. Contacts 3255 are connected to the busy tone, so that if it happens that all trunks are occupied, the calling subscriber will receive the busy signal and be induced to release. The private contacts 4255 of the several connector switches are not multiplied together. If while all four trunks are occupied, more than one called is received for the busy number, the second and later calls will also stop on 4255 and not be forced past to 4256, which might be assigned to other service.

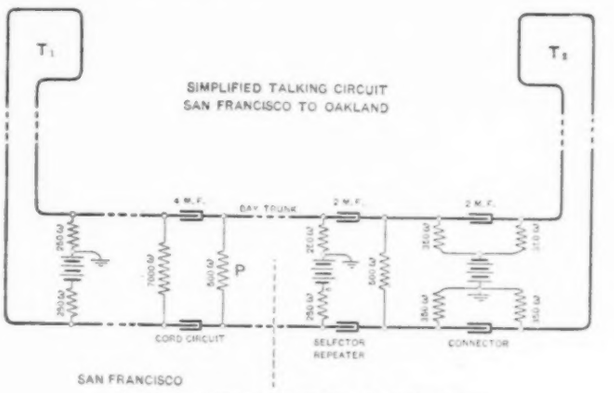


Fig. 5. Simplified Transbay Talking Circuit.

If desired, the remaining four numbers in this same level, 4256, 4257, 4258, 4259, may be given to some other private branch board. In fact, any grouping of the trunks of a level may be used, it being only necessary to reserve one set of contacts at the end of each group for busy indication.

The trunks to private branch board are treated exactly like subscriber's lines in the public exchange, each being wired to a line switch for calls to the automatic system. They terminate in jacks and signals on the manual private boards and can be used for establishing connection either to or from the subscriber. The operator is provided with a calling device which may be switched by keys to any cord circuit. With this the operator calls into the automatic exchange and arrangements are made so that complete double supervision is secured on all calls.

In the case of a private branch exchange having sufficient magnitude of business to require it, the trunks leading from connector banks may be made one-way only and reserved for calls to the branch board. There will then be installed as many trunks from the latter to the public exchange as are necessary, these trunks being attached to the line switches. The number of trunks is not limited by the number of contacts in a level of the connector bank.

Transbay and Suburban Toll.—We now come to what is perhaps the most interesting feature of the combined telephone exchanges. On account of the relative positions of the two cities, and their close business and social relations, the matter of quick and satisfactory communication between them is of great importance.

The fact that a charge is made for all calls between the two cities makes it necessary to employ operators for putting up these connections, making records of the same.

Long distance toll work is necessarily handled in a different manner from suburban calls. In the former, the telephone company agrees to bring together two persons, in the latter merely two telephones. This is sometimes called the "two number basis" inasmuch as only the two

numbers are recorded, no attention being paid to names.

A common method of handling suburban as well as long distance calls is to have each call received by a recording operator, who makes out a ticket. She tells the subscriber that he will be called when the line is ready The ticket is then passed to a line operator, who calls the distant city and with the co-operation of a similar operator there, establishes the desired circuit. She then calls the station whose number was given by the person originating the call and allows the conversation to take place.

For the suburban work between San Francisco and Oakland it was thought best to abolish this slow procedure and use what is known as the "rapid fire" method. Accordingly provisions were made for allowing the recording operator at San Francisco, for example, to complete the call into the Oakland exchange by a calling device in San Francisco, and to allow the conversation to proceed at once. This virtually makes the recording operator a line operator and entirely dispenses with the services of a line operator to complete the connection in the distant office.

The recording operator is of course obliged to ask the subscriber who originates the call for his telephone number so that the cost of the toll service may be properly charged. It is to be expected that, either by accident or intention, wrong numbers will sometimes be given. To

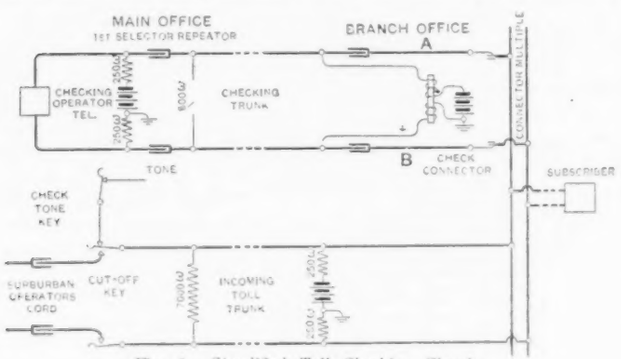


Fig. 6. Simplified Toll Checking Circuit.

prevent error from this source a system of back checking has been devised, which will be described in detail later.

The operators are divided into two main groups, suburban and long distance. The latter are as usual made up of recording operators and line operators, each with the usual duties assigned.

The suburban operators work in pairs or threes and are termed suburban operators and checking operators. All calls for out of town come to the suburban operators, who act as distributors between the two boards. This is because of the relatively heavy nature of transbay and suburban service as compared to long distance service. The suburban operator puts up suburban connections while the checking operator verifies the correctness of the number given by the calling subscriber. Usually one checking operator verifies the work for two suburban operators, though during periods of light load the latter check for themselves.

The method adopted in making a call is as follows: The subscriber takes his receiver from the hook and calls the digit "0" on the dial. This lifts the wipers of a first selector to the top level and selects an idle trunk to the suburban board. Here a lamp attracts the attention of a suburban operator who answers the call by plugging into the jack and throwing the listening key on her cord circuit. She asks whether "suburban" or "long distance" is wanted. If the latter, she momentarily depresses the transfer key button associated with the trunk in use. This automatically transfers the call to he long ditsance recording board, where multiples of the incoming trunks appear. The proper operator, seeing the burning lamp, answers and cares for the call in the usual way.

If, however, the subscriber replies that he wants "Suburban," the operator asks him two questions.

"What number do you wish?"

"What is your number?"

This information she writes on a ticket together with the number of the incoming trunk over which the order was received. The pad of tickets bears the suburban operator's position number and is arranged to furnish duplicate copies. Having recorded the information she passes the duplicate ticket to the checking operator who is seated directly in front of her. The two following operations are then performed simultaneously.

The suburban operator selects an idle outgoing trunk leading across the bay and calls the number in the distant exchange by means of her dial. The checking operator upon receiving the ticket plugs into the multiple of the incoming trunk shown thereon. Then by an independent set of apparatus she calls the number of the originating subscriber. If the checking operator finds that the number written on the duplicate ticket is wrong, she passes the ticket back to the suburban operator by dropping it in a special ticket box in plain view. The latter operator at once throws the cut-off key on the cord, thereby severing the connection from the outgoing transbay trunk. She then requests the calling subscriber to repeat his number. If he repeats the number previously given, she informs him that she can not reach him over that number. In most cases the subscriber now corrects his mistake by giving the true number. This is now entered on the tickets and the duplicate again passed to the checking operator for verification. Uusually the suburban operator allows the connection to proceed, while the second check is being made, for, as a rule, the second number is found to be correct.

On the suburban operator's cord circuit is provided two supervisory lamps which have the usual functions. The calling supervisory lamp burns till the subscriber in the distant office answers. Then the operator stamps the ticket in a calculagraph. At the end of the conversation both subscribers hang up the receivers. This lights both supervisory lamps. The operator then times the ticket and discounts the circuits.

The completed circuit over which conversation is carried on is shown in simplified form in Fig. 5. It is balanced and quiet in service. The rapid break and make of the calling device in operating the switches through the cable under the bay causes no inconvenience to those using parallel trunks.

When a subscriber has secured connection with the suburban or toll board, it is necessary that he be permitted to signal the operator by moving his receiver hook up and down. This would ordinarily cause the release of his first selector since all automatic switches are arranged to be released by the depressing of the hook lever. To prevent this breaking of the connection a special arrangement is attached to the outgoing toll trunks from each office in place of the regular repeater. This enables the release of the first selector used by the subscriber to be controlled by the operator.

After the subscriber has hung up, the operator pulls

out her plug which automatically causes the release of the first selector.

Toll Checking Apparatus.—In the preceding general description of the mode of operation, reference was made to the toll checking operator and her apparatus. The general plan of checking is to connect to the incoming toll trunk in use a source of alternating current which produces a musical tone. By independent automatic switches the checking operator calls the number given. If correct she will obtain connections to the same line as that over which the call was received by the suburban operator, and by listening can hear the tone. The condition is shown in Fig. 6. The subscriber at the right has called the suburban operator over the incoming toll trunk. The operator has answered and made out the ticket. The checking operator has used a checking trunk to secure connection with the number given. At this point she presses the check tone key which connects to the incoming toll trunk a source of alternating current which produces a sound differing from the regular busy tone of the exchange. If the number is correct, the tone will be carried back over the toll trunk to the connector multiple and thence over the checking trunk to the checking operator.

The ordinary connector cannot be used by the checking operator in picking up the calling subscriber's line, because the latter is protected by a busy test which will not permit an ordinary connector to establish connection. For this work one check connector is provided in each hundred group. It is devoted exclusively to testing and checking. It is provided with three pairs of wires, one pair (*A* and *B*) for carrying the tone, another pair (+ and —) for operating the magnets for lifting and rotating the wipers and a third pair for auxiliary purposes.

The checking operator secures connection with the check connector in any hundred in any office by a system of first, second and third selectors which is entirely separate from the regular apparatus of the exchange. One first selector repeater is provided for each checking operator, to enable her to select a trunk to any office in the exchange. In each office as many second selectors and third selectors are provided as are necessary for the work, the number varying in the different offices. These are operated by a calling device located at the checking operator's position.

When the checking operator plugs into a connection it lights a red lamp associated with the suburban operator's cord circuit. This shows that the checking operator has picked up the trunk. When the checking operator has verified the number and withdrawn her plug the red lamp is extinguished, thus notifying the suburban operator that the number has been checked and is correct.

As a guard, tending to prevent the checking of wrong trunks, the checking operator's cord circuit is provided with a lamp. This lamp will light when plugged in on a trunk which is waiting for the completion of a connection. If, however, the checking operator by mistake plugs in on a non-busy trunk, or one over which a connection has been completely established the lamp will not burn.

Credit and Cash Tolls.—The larger proportion of the calls between the two cities are handled on the credit basis. From the records of the toll tickets, statements are made out at regular intervals and sent to the subscribers for payment. For such public places at which it is desirable to collect cash for suburban and long distance service, a regular coin box is attached to the telephone. The dropping of the coin gives a signal which reveals its denomination to the operator.

Two-Three-wire Operation.—In the general description of suburban toll operation a short reference was made to the trunk lines connecting the two cities. For the purpose of giving a better idea of the arrangement, a trunk line will be described which handles calls from San Francisco to Oakland.

The work of interconnecting the two exchanges was rendered more difficult by the fact that the Oakland apparatus is three-wire, while that of San Francisco is two-wire. The two-wire system requires only the opening and closing of the line circuit. The three-wire system requires each line wire to be grounded in a certain order. The San Francisco recording operator using a two-wire calling device was required to operate three-wire selectors and connectors in Oakland, in some cases as far as thirteen miles away. This was done by means of repeaters which handle the impulses somewhat like a telegraph-repeater, except that it is necessary to transmit impulses only one way.

Each transbay trunk from San Francisco to Oakland ends in multiple jacks with visual busy signals on the San Francisco suburban board, and in a first selector-repeater in the Main office in Oakland. This switch is a first selector, to pick out trunks to the desired office in Oakland, combined with a repeater arrangement to convert the simple make and break of the two-wire system into the alternate grounding of vertical and rotary lines required by the three-wire system. The release of the connection as well as proper supervision is also provided in the repeater.

The operator is provided with a set of plugs and cords with which to connect incoming trunks from San Francisco subscribers to outgoing trunks to Oakland. A calling device is mounted on the keyboard and arranged to be switched into any cord circuit by keys. When a call comes in over an incoming trunk, it is answered by inserting the answering plug of a cord into the proper jack. An idle outgoing trunk to Oakland is selected by inspection of the visual busy signals, and the calling plug of the cord in use inserted into the jack. The calling device is then switched into the cord circuit and rotated in accordance with the desired number. This operates the switches in Oakland.

The supervision is accomplished as follows: Across each cord circuit of the suburban operator in San Francisco is bridged a polarized relay. Normally the current from the first selector repeater in Oakland is in such a direction as to cause the relay to light its associated lamp. In the Oakland exchange the circuits from the first selector through to the connector are three-wire. When the called subscriber answers, it causes the rotary line to be switched from negative battery to ground or positive battery. This energizes a pair of relays in the first selector repeater which reverses the current supplied by the latter to the operator's cord circuit in San Francisco. This reversal causes the bridged polarized relay to operate, extinguishing the supervisory lamp.

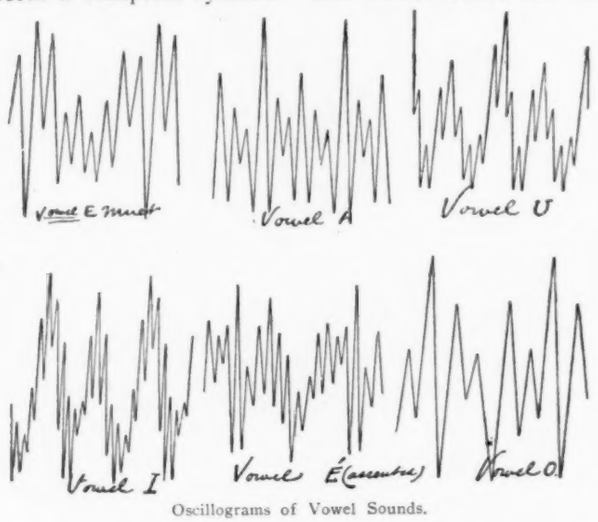
The release of the three-wire Oakland apparatus calls for the monetary simultaneous grounding of the vertical and rotary lines. The two-wire first selector repeater at the Oakland end of the transbay trunk requires only the simple opening of its line circuit. By a suitable arrangement this is made to cause the release of the three-wire apparatus according to the manner just indicated.

The Structure of Vowel Sounds

By Henri Destynn

A SERIES of researches recently conducted by M. Devaux-Charbonnel, of the Paris Department of Posts and Telegraphs, has developed a number of interesting side-lights on the structure of the human voice. The experiments of Helmholtz with resonators, of Hermann with phonographic impressions, and of Koenig with manometric flames, are recalled in this connection.

M. Devaux-Charbonnel's work was developed by means of a telephone transmitter combined with an oscillograph, and the record of the waves obtained in the latter instrument was examined. It is to be noted that the study of the vowel sounds is the most important for understanding the structure of speech, as they play the principal part in spoken language, and it will be observed that the consonants serve only to modify the beginning or end of a vowel in order to form a complete syllable. The vowel sound has the longest duration, and therefore the researches bear especially upon these sounds.



Oscillograms of Vowel Sounds.

The telephone is found to reproduce the voice, at least for short distances, with great exactness, hence it can be used to advantage. As the oscillograph is used for registering vibration effect even of short length, by combining the telephone with the oscillograph the waves of the voice can be registered upon the photographic plate. In the method of mounting the apparatus the Blondel oscillograph is used. A moving mirror vibrates under the action of the telephonic currents, and this causes the wave form of such currents to be thrown upon a screen. Owing to the nature of the curves, it was to be supposed that they were made up of a series of vibrations such as a fundamental note and its harmonics, and this in fact proved to be the case. M. Devaux-Charbonnel succeeded in decomposing the complex wave which was obtained for each of the vowels into series of waves, and these are found to be a fundamental note and a series of harmonics, varying according to the nature of each vowel. In order to carry this out, he took photographic plates for each vowel sound and enlarged these by projection so that he could obtain curves of 20 inches height. The structure of the vowel waves was thus easily seen. In order to decompose the vowel wave into its harmonics, he proceeds by a method of elimination.

The real structure of a vowel sound is readily observed in this way, and some interesting points are developed. The fundamental note is seen to be of a less intensity than the various harmonics. Taking the case of the vowel *A*, where the fundamental note is represented as unity, the second harmonic has a value of 1.7, the fourth harmonic 3.0, and the sixth harmonic 4.8. Here the sixth and the fourth harmonics are predominant, while the fundamental and the remaining harmonic are much less prominent. For the vowel *O*, the fifth harmonic predominates, and has about four times the value of the fundamental note. For the vowel *I*, the second harmonic has about four times the value of the fundamental, and the thirteenth harmonic has nearly three times the value. It is natural that the vowel *I* should contain sharper sounds, that is, higher harmonics than the vowels *A* or *O*, and this is seen to be the case here.

Another interesting point which is observed is that according to the above analysis of the waves, each of the vowel sounds generally contains a note which is more prominent than the others of the series. The vowel is therefore characterized by this note. Taking the fundamental note to be 160 vibrations per second, such as was observed in the present case for each of the vowels pronounced by a male voice, the most prominent wave in the vowel *O* is the fifth harmonic, and as above noted, this is four times as strong as the fundamental. As the latter has 160 vibrations per second, the fifth harmonic will have five times this number, or 800 vibrations per second. The note which corresponds to this number of vibrations is therefore prominent in the vowel *O*. In like manner the vowel *A* is characterized by a note which corresponds to 960 vibrations per second. For the vowel *I*, the second harmonic, corresponding to 320 vibrations, is the strongest, but very near this value lies the thirteenth harmonic, which gives a note of 2,080 vibrations per second. It is the presence of this high note which gives the sharper sound which we observe in the vowel *I*, while the vowels *A* and *O* do not contain a note which is nearly as high as this, as might be expected from their lower or graver sounds.

The values for the characteristic notes of each vowel are nearly in concordance with what were obtained by Helmholtz, Koénig, and the other experimenters mentioned above. This is due to the fact that in general the range of the male voice as regards speech lies at about the same value, this being near 160 vibrations per second. It must not be supposed, however, that each of the vowels has a certain pitch or fixed note which characterizes it, as might be supposed where the form of the wave could not be clearly observed. By the preceding examples it seems to be evident that the characteristic note is not

separate and distinct, but is a harmonic of the fundamental note in each case. What is therefore striking in the researches seems to be the fact that each of the vowels contains a fundamental note of about 160 vibrations per second, together with various harmonics whose presence and value change with the different vowels, and that some of the harmonics may be much stronger than the fundamental note, so that they appear to make up the greater part of the vowel sound for each particular case.

In the above experiments the vowel sound was given before the telephone in a continuous manner, and this in fact somewhat resembles a musical sound, as it has a regular form. However, in ordinary conversation the vowel sounds are not pronounced in this way, but are combined with the consonants. It was therefore desired to find the effect of spoken syllables. To register these, a moving film was substituted for the fixed photographic plate. The film rolled upon a cylinder placed at one end of the opening so that a flat portion could be moved across the path of the waves for a certain time, say one second, and we can now register the waves for several syllables. By pronouncing a series of vowels in succession, *A O I E*, for instance, we find that each vowel is composed in its main part of the waves which we observed above, but there is also an initial and a final period for each vowel, in which the sound increases or again diminishes. This period contains four or five vibrations.

As to the effect of consonants upon the waves, the presence of the former (which give an irregular trace) modifies the wave of the vowels during four or five periods. Each of the consonants has a different effect upon the vowel wave, but the vowel is generally not modified for more than the above-mentioned amount. It is found that speech is thus not an exactly regular periodic phenomenon, but it is composed of regular (or wave) periods which are placed between quite different phenomena which are caused by the passage from one vowel to another, but these irregular periods are of comparatively short duration. It is observed that not more than five or six syllables per second can be clearly emitted by the voice, and above ten syllables per second the words are no longer intelligible. For an ordinary male voice whose fundamental note corresponds to 160 vibrations per second, a single syllable will take in about 30 vibrations or periods. Of this number, there will be more than 20 which correspond to the vowel sounds alone and which show a very regular character. For the ear, this part is the most prominent one of the phenomenon.

To sum up, it must be concluded that the human voice is to be recognized as a sound rather than a noise, that is, the voice is formed of a succession of vibratory phenomena whose greater part is of a regular vibratory character.

The above considerations relate to the general theory of speech, but M. Devaux-Charbonnel considers that they will throw light also upon the question of telephonic currents, and he expects to make further researches upon their use in the field of telephone work in connection with instruments and telephone lines.

Recent Telephone Patents

By David S. Hulfish

951,864. Transmitter. The resistance cell has a plurality of carbon chambers. Walter Whitten, Schenectady, N. Y.

951,918. Jack Box. As an intercommunicating switching set, the home telephone has a central jack, and the remaining lines form a circle of jacks around it. A twin plug will connect the home jack to any other without the use of a flexible cord. Harry O. Rugh, Sandwich, Ill., assignor to Sandwich Electric Company, of same place.

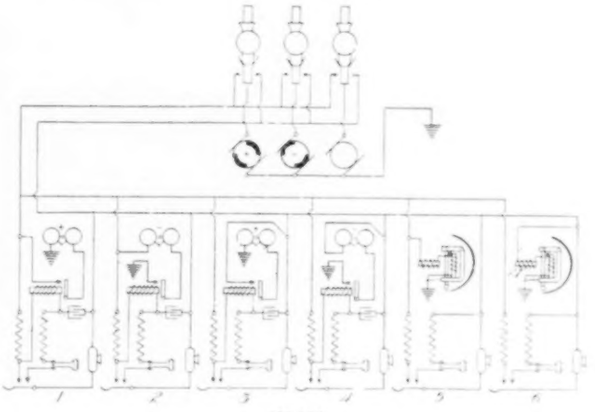
952,104. Switchboard System. This patent covers a specific application of the well known Vote-Berger ballast lamp method of telephone signalling. The line lamp is short-circuited when the switch plug is inserted into the jack of the three-wire multiple, and the supervisory lamp is bridged across the line conductors upon the subscriber's side of the impedance coils. The supervisory signal is shunted out by the subscriber's telephone bridge so long as his receiver remains off the hook. Claude D. Enochs, La Crosse, Wis., assignor to The Vote-Berger Company, of same place.

952,164-5. Mouthpiece. These two patents cover details for attaching a mouthpiece to a transmitter front, the attachment being of such nature that it is adapted to hold a glass mouthpiece, or oher mouthpiece not capable of taking screw threads of the usual nature. Montraville M. Wood, Berwyn, Ill., assignor to W. H. Foll, Freeport, Ill.

952,267. Switchboard System. A system embodying a ringing key for ringing continuously or intermittently until the subscriber answers, and then automatically releasing the ringing generator. The novelty consists in the application of a thermal relay instead of the usual electro-magnetic relay. Ray H. Manson, Elyria, Ohio, assignor to Dean Electric Company, of same place.

952,557. Attachment. A container for antiseptic is screwed into the lower wall of the mouthpiece, being flush with the inner surface. Alfred K. Young, Pittsburg, Pa.

952,567. Telephone System. A system adapted for use with party lines. The object is to announce to the operator by an audible signal when the line called is one of the lines recently answered by her, in order that she may take further steps to determine whether the station asked for is located upon the same line with the calling station. The mechanism is adapted for automatic-Y switching systems. David S. Hulfish, Chicago, Ill., assignor to McMeen & Miller, of same place.



953,082.

953,082. Selective Ringing System. Two biased ringers, one for each polarity, are rung from each of the line wires to earth, and one direct-current ringer is operated from each line wire to earth, thus affording six different selections. Condensers and

relays are used in connection with the biased ringers, the relays thus being made unresponsive to the direct currents for the fifth and sixth stations of the line. Fred E. Winslow, Des Moines, Iowa.

953,102. Transmitter. The variable resistance of the transmitter is subdivided into a number of small groups of granules, all of which are in contact with the diaphragm and its back electrode, the current being divided among the several groups of granules. Philip G. Randall, Malden, Mass.

953,107. Telephone Voice-Current Relay. A differential microphone comprising two separate microphones, one electrode of each connected to the receiver diaphragm or armature of the receiving coil of the relay. Pietro Stragiotti, Hurley, Wis., assignor of parts to Griffith Thomas and Joseph Vercellini, of same place.

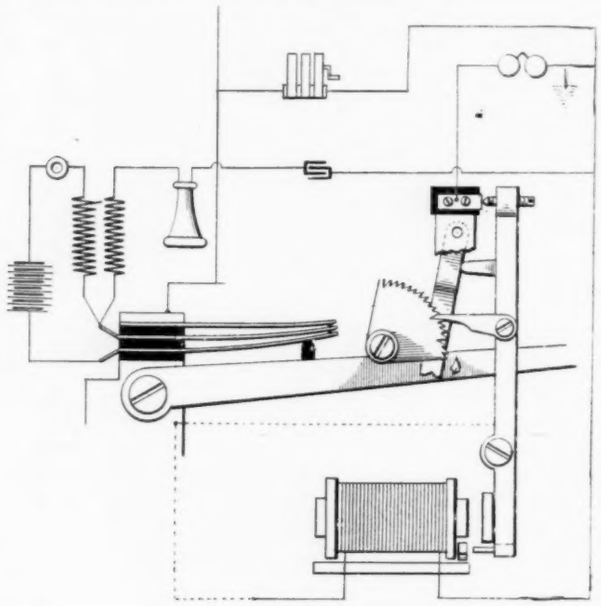
953,306.

953,188. Telephone System. The listening key interrupts the battery from the calling plug when the operator listens upon the plug pair prior to the answering of the called party, but not subsequently thereto. Alfred H. Weiss, Chicago, Ill., assignor to Kellogg Switchboard & Supply Company, of same place.

953,306. Electrical Contact. Economy in platinum is the object. With platinum selling at three times the price of pure gold and the market going higher day by day, the object seems a commendable one to the telephone manufacturer. Two thin plates of platinum are attached to the sides of the switch spring instead of a solid platinum rivet as has been the custom heretofore. Walter F. Taylor, Brookline, Mass., assignor to Holtzer-Cabot Electric Company, of same place.

953,340. Lockout Telephone. A stepping selecting device, with mechanical lock for holding the hook lever down. Daniel W. Kneisley, Dayton, Ohio, assignor to the Dayton Telephone Lockout Company, of same place.

953,344. Call Register. The patent covers details for a substation register of the type in which the reading of the substation device may be transferred to the central office electrically, thus permitting the reading to be taken without visiting the substation. John Merckens and Anton J. Herrick, Chicago, Ill., assignors to James E. Plew, of same place.



953,340.

953,394. Cable Hanger. A metal U to span the messenger wire has an eye at one end and a hook at the other, and a marlin loop for the cable is held by the two ends. Charles L. Peirce, Jr., Chicago, Ill., assignor to The W. G. Nagel Electric Company, Toledo, Ohio.

953,635. Wireless Telephone System. A system of wireless transmission of electro-magnetic waves having a source of power conductively connected to the oscillator circuit and inductively connected with the radiator circuit. John Muth and Christian F. Heinkel, Cleveland, Ohio.

953,442. Attachment. A device for supporting the receiver when in use and for operating the switchhook lever when not in use. Thomas W. Small, Cleveland, Ohio, assignor to The Acme Automatic Street Indicating Company, of same place.

953,951. Cable Hanger. A wire U spans the messenger wire and a wire loop encompasses the cable and engages the U at its ends. Richard W. Hubbard, Ashtabula, Ohio.

953,970. Receiver. The diaphragm is composed of a circular iron disk with other smaller circular iron disks mounted upon it concentrically, thickening the diaphragm at the center. Jay Noble, St. Louis, Mo., assignor of one-half to Charles W. Chamberlain, of same place.

954,167. Ringer. This harmonic ringer has its armature-suspension spring attached to the armature at its two ends and to the frame at the middle. Peter C. Burns, Chicago, Ill.

964,372. Mouthpiece. A sound-concentrating funnel is adapted to slip into the transmitter mouthpiece. Hans H. Berg-Yager, Christiania, Norway.

954,402. Telephone Repeater. A circuit arrangement for a differential telephone relay, designed to use the differential voice-current relay produced by the same inventors. Pietro Stragiotti, Hurley, Wis., assignor of parts to Griffith Thomas and Joseph Vercellini, of same place.

No Rate War in Ohio

Bell telephone long-distance rates have been advanced to their former schedule before the reduction of something over a year ago, and there will be no new schedule of rates issued at present by the United States Telephone Company.

The committee appointed by the Ohio Independent Telephone Association to act in conjunction with President Davis of the United States Company to revise the rates will now advise only that some adjustments be made. With the Bell rates much lower than those of the independent company, the Bell local companies were getting the business and the independents proposed to meet the Bell cut.

Now that the latter has advanced its long-distance rates there is no necessity of starting a telephone rate war, and about the only action taken in the independent long-distance rates will be to equalize them so that they will be uniform over the state for equal distances. In some cases the independent rates are higher yet than the Bell, and these will probably be reduced to a similar level. Both Bell and independent companies report heavy business, saying that they are caring for about all the traffic their lines can carry.

Exclusive Contracts Held Void in New York

Telephone companies cannot enforce a contract for exclusive service, according to a decision given in the action of the Central New York Telephone and Telegraph company against the proprietors of the Yates hotel at Syracuse.

A contract was entered into whereby it was agreed the hotel would use exclusively the Central company's telephone for nine years. Later the hotelkeepers sought to introduce another telephone and the company brought suit to restrain them.

The Court of Appeals holds that such a contract would shut out customers of rival companies from telephone communication with their neighbors. It condemns "the exclusive clause of this contract as against public policy and therefore void."

DEPARTMENT of RAILWAY TELEPHONES

Annual Railway Telegraph Convention

Superintendents at Los Angeles

AS we go to press there is being held in the city of Los Angeles, Cal., the twenty-ninth annual convention of the Association of Railway Telegraph Superintendents, the first having been held in Chicago in 1882. In spite of the fact that great advances have been made since the association was formed and many interesting problems have been solved, the present sessions bid fair to outrival all former sessions, as many questions of vital importance to this branch of railway service are presented for discussion.

The telegraph department of a railroad is often regarded by other departments as of little consequence, because of the fact that it produces no revenue. Notwithstanding this view of the matter the fact still remains that it is only through its efficient service that the other departments are enabled to operate at all and it is difficult to imagine conditions in railroad circles entirely divested of the use of the telegraph or telephone for use in directing trains. The nearest approach we can have to a realization of these conditions is when the system is suffering from the effects of a sleet storm or some unusual electrical phenomenon; everything is practically at a standstill. Not only does the efficient operation of the freight service depend upon the efficiency of the service rendered by the telegraph department, but every passenger who enters upon a journey of any length virtually places his life in the hands of some manipulator of the keys, it may be some obscure subordinate in the isolated tower. Thus we see the importance of the position and the responsibility which rests upon those having this system under their supervision, as they hold in charge not only material possessions but life itself.

It was the realization of this responsibility on the part of superintendents of telegraph, wide awake to the importance of their position and desirous of using every known means to increase the efficiency and reliability of their systems, that led to the formation of the Association of Railway Telegraph Superintendents in 1882. In their efforts to maintain a system as safe and reliable as it is possible for any human agency to make it, they realized the benefits to be derived from co-operation and an exchange of ideas through the discussion of important problems.

The various subjects assigned by the present session cover a multiplicity of problems which will be handled by experts in each line and the discussion which follows will be carried on by those who can speak from actual experience. No doubt a comparison of the present program with the program of the first or even more recent conventions, would reveal the fact that nearly all of the questions which are of moment to the railway telegraph superintendent today are of recent origin. And although there were difficult problems to be solved in the beginning, as is always the case in pioneering any enterprise, still the more highly complex a system is the greater the complexity of operation, and the operator of today has things to contend with which were not known a few years ago.

One thing which the present day telegrapher has to contend with, the use of high voltage in the transmission of electrical current, had not been thought of a few years ago. In the last ten years high tension transmission systems have sprung up everywhere and the telegraph superintendent has been confronted with the problem of avoiding any possible contact between these deadly wires and the low voltage telephone and telegraph wires where they are in close proximity. A committee composed of members of the association has been considerating this question for the past two years, carefully investigating the safest types of construction which have yet been devised by human ingenuity for meeting these conditions, and is bringing the results of its investi-

Department of Railway Telephones

This department is established as a permanent feature of TELEPHONE ENGINEER. The progress of the art of telephone train dispatching, its technical developments, its news, and the elucidation of its mysteries for the non-technical worker will be found each month in these pages. The editors invite the problems and solicit the co-operation of the many readers of TELEPHONE ENGINEER in all parts of the world whose interests lie along these lines.

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gation before the convention for its consideration.

The factor which has introduced the newest set of problems for the telegraph superintendent is the telephone, the more important of which are given due consideration by the convention. It is only recently that this factor has had to be taken into consideration, but now that its advantage over the telegraph in the way of facility in directing train movements has been realized, its use has increased rapidly; even to the point where it has been recognized that it would be advantageous to have some standard to go by in the interchange of business with the telephone companies. To this end the American Telephone and Telegraph Company has proposed a standard agreement to be entered into between the two parties concerned and this matter, which has been carefully considered during the past year by a committee composed of the members of the association, is presented to the convention for discussion and final action.

During the past year the mileage of railroads on which the telephone is used for dispatching purposes has been doubled and present indications point to the same comparative increase during the coming year, as all of the more important railroads are extending the use of the telephone as rapidly as is practicable. It is not to be inferred that telephone dispatching has been perfected beyond further improvement. This can only be done by actual operation whereby the weak points may be discovered and pointed out. The discussion of the failures and successes along this line, one of the principal questions brought to the attention of the convention, will aid much in attaining the desired perfection. The fact that there have been no failures among the many telephone train dispatching installations which have been placed in service during the past three or four years, is attributed to the co-operation secured by the superintendents through this association, enabling them to profit by the failures and successes of their fellow laborers who have the same problems to meet. As a result the use of the telephone for train dispatching has been extended to over twenty-six thousand miles of railroad today.

The committee in charge could probably not have found a more attractive city than Los Angeles in which to hold the convention of the Association of Railway Telegraph Superintendents now in session in that city. Its location, climate and soil have combined to make is one of the most attractive cities of the United States. Although the first settlement dates as far back as 1781, still it was not until more than a hundred years later that it began to show any signs of growth. The first railroad from the east entered the city in 1885, since which time its growth has been phenomenal, its population having increased from 100,000 to 300,000 since 1900. Situated as it is near the Pacific, which can be reached by a short ride, adds to its many advantages. Nature has done much for the city in surrounding it with rugged scenery, but man has done more. He has in reality made the desert to blossom with the rose and luxuriant vegetation. Standing on the summit of Mt. Lowe a short distance out of the city there is spread out before the observer a vast panorama of cultivated gardens all laid out with apparent geometrical precision, extending almost as far as the eye can reach. The committee of arrangements did not overlook these vantage points as ample preparation was made to have its guests visit the main points of interest.

Santa Fe Makes Big Telephone Extension

The Atchison, Topeka and Santa Fe Railroad has for some time been conspicuous among the great railroad systems of the country which have been discarding their faithful servant and companion of sixty years —the telegraph. New extensions to the Santa Fe's telephone system of dispatching have been made frequently since this road placed in service its first telephone circuit two years ago. The latest news from this railroad is that 4,600 more miles are to be equipped with the telephone. The outside construction work is already well under way.

The Santa Fe's new telephone circuits will reach from Kansas to the Pacific coast and far into southern Texas. Eventually all traffic and train movement on that railroad will be directed by telephone. Today there are 2,275 miles of telephone circuits, and the additions to the system will go a long way towards unifying the entire dispatching system.

The Santa Fe was one of the very first to supplant the telegraph in this kind of work. In 1908 this road first used the telephone, and the new system proved successful from the start. Other circuits were installed on widely separated sections of its railways to test out thoroughly this system under varying climatic and track conditions and a similar success was reported. So far did the telephone surpass the seemingly adequate telegraph in efficiency, ease of operation and economy, both of time and labor, that plans immediately were laid for its adoption as a future method of dispatching trains.

A recent installation was made over the Santa Fe's track between Denver and Pueblo, Colorado. This is a single track division, over which heavy traffic is carried on. Since the introduction of telephones on this division, the dispatcher has been able to handle the same amount of work as previously, at a saving of about forty per cent in time.

The telephone is now to be installed over the tracks from Newton, Kan., west to Mojave, Los Angeles and San Diego, Cal.; from Newton south to Gainesville, Texas; from Temple, Texas, to Galveston, Texas; from Temple to Brownwood, Texas, and from Wichita, Kan., to Clovis, N. M.

The equipment for the Santa Fe telephone system is being furnished by the Western Electric Company.

Chicago and Milwaukee Electric Builds Own System

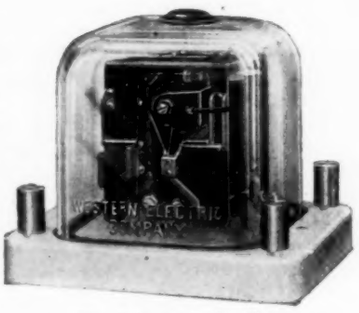
The Chicago & Milwaukee Electric Railroad Company recently constructed a new telephone system for handling its train dispatching and company business. A twenty-drop switchboard was installed in the office of the superintendent at Highwood and is in charge of a train dispatcher. About 500 miles of wire, the larger part of which is No. 10 B. & S. gage bare copper, were strung for the telephone circuits. From Highwood the circuits extend north and south, connecting Evanston and Milwaukee, and west on the Libertyville division. A running form of transposition is used. Transpositions are spaced every 500 ft. Five-bar generators are used in the instruments on the line for calling the dispatchers, who work in three shifts of eight hours each, and use a headpiece so that they can listen in on the line at all times.

The new lines are installed in duplicate on all branches, each telephone arranged so that it may be connected to either line.

A Selector with Some New Features

By K. W. Endres

RECENT data compiled by the Block Signal and Train Control Board of the Interstate Commerce Commission says that 295 railroads in the United States are dispatching trains by telephone over 26,344 miles of line. On approximately 20,000 miles of this, the selective system of telephone train dispatching is employed, and the development of the telephone art as applied to railroad conditions is one of the wonders of the past few years.



The Selector in Its Case.

The latest mechanism which has been designed for this purpose is the Western Electric selector, which has recently been put on the market by that company. This selector is a high speed, individual call mechanism and is simple in the extreme.

The selector consists of two electro-magnets or magnets or relays which are connected in series across the line; these are of a very high impedance and the number which can be bridged across a telephone circuit without affecting transmission is practically unlimited. These magnets are mounted in a brass frame-work on the front of which the moving parts of the mechanism are fastened; the armatures of the two magnets are at the bottom of the selector.

The simplicity of this selector lies in the fact that there is practically nothing to get out of order, and if anything does happen to the moving parts, their operation is so clear that it can be adjusted and cared for by any ordinary maintenance man.

The moving parts consist of a ratchet wheel to which is fastened a contact; this wheel is stepped around by means of a hardened steel spring pawl at the top of the mechanism. This pawl and a corresponding one on the under side of the ratchet wheel are connected directly to the armatures of the magnet and therefore as long as the magnet operates, the pawl must move.

The contact is adjustable so that one standard form of selector is supplied at all stations. The position of the moving contact with reference to the ratchet wheel and the stationary contact determines which station shall be called, and this adjustment is simple and can be made without difficulty. It is thus seen that a selector can be taken out of one station and used in another by changing its adjustment if such a thing becomes necessary in case of emergency.

The selector is mounted on a porcelain base with heavy brass binding posts for the terminal wires. The glass cover sets in a felt-lined groove on this base and is locked by a bolt and nut passing clear through the selector. It is thus rendered inaccessible to the way-station operator but can be removed if necessary by a maintenance man.

The selector is normally operated on the central energy principle—that is, the battery for stepping it around as well as the battery for ringing the bell is located at the dispatcher's office. It can, however, be arranged for local battery service if so desired.

The operation of the selector is as follows: In front of the dispatcher are a number of keys, one for each equipped station on the line. These keys are practically noiseless, and each one sends out a number of rapid direct current impulses on the line when it is operated. The number of impulses which are sent out can be regulated by adjustable cams on the rear of the key so that a standard key is employed in all cases and adjusted for the particular station desired. This is an improvement in train dispatching service.

The first impulse which one of these keys sends out is a long impulse, the tooth being three or four times the width of the ordinary tooth. This impulse operates the magnet on the right-hand of the selector, which is a slow acting relay; it pulls up the armature of this magnet, which in turn causes the two pawls to engage with the ratchet wheel. The remaining quick impulses which the key sends out operate the magnet on the opposite side of the selector, but do not affect the slow acting magnet, which remains held up; these quick impulses work the pawl which appears at the top of the selector and step the ratchet wheel around the proper number of teeth, at which point the two contacts make and the bell in the station is rung.

The remainder of the revolution of the key, after the signaling impulses are complete, keeps the key contact closed and therefore keeps battery on the line during a period of about five seconds. As long as

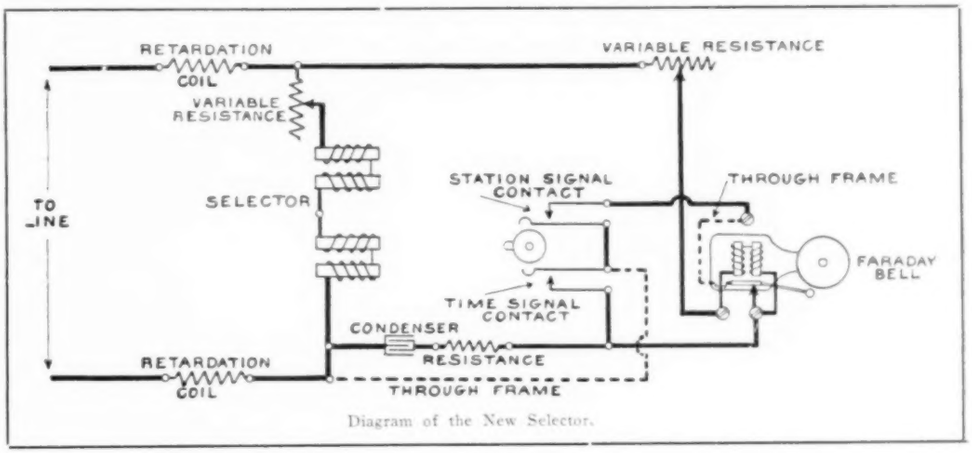


Diagram of the New Selector.

this battery is on the line, the bell at the way-station rings.

By installing a simple strap key, the dispatcher can hold this down and make the way-staton bell ring as long as he pleases, this strap key merely taking the place of the key contacts and keeping the circuit closed.

The selector is high speed in its operation. It requires approximately three seconds to call the thirtieth station on the line, and any one of the first ten stations will be called in one second or less. It is possible to place as many sets on the circuit as may be desired, the number being limited by the size of the ratchet wheel. The present selectors which are installed are equipped to care for fifty stations, which would cover the majority of train dispatching districts.

The schematic diagram shows how the selector is wired across the circuit, and also illustrates some of the auxiliary apparatus which is used in connection with it. Retardation coils are employed to choke back any lightning which may get by the protectors at a station. A variable resistance is required at each selector, since each must receive approximately the same current and voltage, and if this were not installed, the high voltage near the dispatcher would give the stations adjacent to his office much more current than they should obtain. The Western Electric selector requires approximately eight milli-amperes to operate and ring the bell and thirty volts across its terminals.

It will be noted on the schematic diagram that two contacts on the selector are shown. One of these is the station signal contact which normally rings the bell at the station when the train dispatcher wishes to call in the operator, and the other is a time signal contact which is operated by a special key in the dispatcher's cabinet and which makes on all selectors along the line simultaneously. The dispatcher can, therefore, with this key give all the way stations along his division a time signal whenever he may so desire. It also permits of his calling in all the stations at once if this ever becomes necessary on special occasions.

The condenser and resistance shown bridged around the contacts of the Faraday bell and in series with the windings of the bell are for the purpose of eliminating any spark at this contact and also serve to render the answer back signal of the proper loudness.

The new selector has been in service on one of the big railroads for several months and no cases of trouble have yet developed. It has also been subjected to severe laboratory tests and the equivalent of many years service has been given it under test. No sign of wear in any respect developed out of 300,000 operations. Much interest is being displayed in the selector among various railroads throughout the country and

Pennsylvania Road Installing Telephones

Linemen have completed the erection of the telephone cable for the Pennsylvania Railroad Company on the Philadelphia division between Harrisburg and Philadelphia, over which the company will transact its train business.

This will mean the abolition of the telegraph line for the transaction of all train dispatching business on the entire Philadelphia division. The telegraph line, however, will be maintained for emergency work.

The company has been using the telephone on the low-grade freight line ever since it was opened several years ago, and now the main line is being equipped.

The company recently equipped the middle division with the telephone system of train dispatching. The trains on the Cumberland Valley are also being operated with the telephone for the entire distance between Harrisburg and Winchester.

With the exception of the Northern Central and the Lebanon Valley branch of the Reading, all of the divisions entering Harrisburg are now equipped with telephones.

The Philadelphia & Reading has equipped all of the smaller branches with the telephone and it is expected that it will be tried out on the main lines in the near future. The Schuylkill and Susquehanna branch, between Harrisburg and Auburn, is being operated under the new system and so is the Gettysburg and Harrisburg branch between Carlisle Junction and Gettysburg.

Lehigh Valley Puts Telephones on Pullman

Following a series af experiments conducted by the officials of the Lehigh Valley Railroad, it has been decided to install a telephone service on all Pullman trains operated between New York and Buffalo. The experiments so far conducted, show that it is possible when a stop is made to alight from the train, and by throwing a wire over the telephone wires that parallel the tracks, to secure communication with any point desired.

Experts are said to be working on a device which may make telephoning possible from the train while the cars are in motion.

Telephones on Interurban Cars

Telephone instruments were installed in the interurban cars which carried the business men on a trade booming excursion recently, so that it was possible for the travelers to keep in touch with their own offices during the three days they were away. When the cars stopped at the larger towns, special wires were connected with the switchboards on the cars and long distance connection with Indianapolis established.

This innovation was arranged by the New Long Distance Telephone Company, and no charge for service was made to the members of the Indianapolis Trade Association. Special operators accompanied the cars to take the orders for connections as the cars ran from one town to another. In case a man desired to write out a message it was telephoned for him, relieving him of all bother.

This special service was arranged for in Noblesville, Tipton, Kokomo, Logansport, Peru, Wabash, Marion and Elwood. In addition, service was also given at the local exchanges.

This feature appealed to a number of heads of large concerns, who had felt that it would not be possible to be entirely separate from their offices for three days.

In the article entitled "Common Battery vs. Magneto," by E. A. Hawkins, which appeared on pages 253 to 256 of Telephone Engineer for June, 1910, the two last paragraphs should have been inserted on page 255, under the sub-head "Convertible Switchboards, following the third paragraph in that division.

Telephones for Manual Block Signals

Interstate Commerce Commission Report

THE following table, compiled by the Block Signal and Train Control Board of the Interstate Commerce Commission, indicates the extent to which the telephone is now being used in the operation of the manual block system on the railroads of this country, as compared to the telegraph.

The total length of road in the United States operated under the block system on January 1, 1910, was 65,758 miles. Of this mileage, 14,237.7 was automatic, and 51,520.3 was manual. There was an increase of 2,047.1 miles in the length of road covered by the automatic block system, and an increase of 4,162.2 miles in the length of road covered by the manual block system, over the figures shown in the report for January 1, 1909. The total increase in the miles of road covered by the block system during the year was 6,209.3.

In addition to the use of telephone and telegraph for the control of manual block systems, electric bells are employed to a small extent by some roads. The Chicago and Western Indiana uses electric bells on 22.2 miles of track; the Erie on 1,331.7 miles of track; the New York, Susquehanna and Western and Wilkes-Barre and Eastern—an Erie line—on 20.7 miles; the Long Island on 28.2 miles; the New York Central and Hudson River on 1.8 miles; the Pennsylvania on 1.6 miles; and the St. Joseph and Grand Island on .3 miles.

In the table below, the first column gives the names of railroads, the second column the miles of track using telegraph and the third column the miles of track using telephone for the control of manual block systems.

Atchison, Topeka & Santa Fe:		
Eastern lines	.....	1,323.4
Western lines*	.....	561.1
Coast lines	.....	.....
Gulf, Colorado & Santa Fe	.....	.....
Atlanta & West Point	.....	.....
Atlantic Coast Line	414.5	166.1
Baltimore & Ohio	1,814.6	2.6
Baltimore & Ohio Southwestern	1,029.7	.....
Baltimore & Sparrows Point	6.0	.....
Bessemer & Lake Erie	298.7	.....
Boston & Maine	.....	.....
Buffalo, Rochester & Pittsburg	546.2	.....
Chicago, Indianapolis & Louisville	537.7	.....
Caldwell & Northern	2.4	.....
Central of Georgia	66.1	.....
Central Vermont	.....	.....
Chesapeake & Ohio	1,357.6	.....
Coal River	.....	69.3
Chicago & Alton	.....	.....
Chicago & Eastern Illinois	207.2	10.2
Chicago & North-Western	2,029.5	616.6
Chicago & Western Indiana	.....	.....
Chicago, Burlington & Quincy	4,956.7	3,004.7
Chicago Great Western	315.7	.....
Chicago, Milwaukee & St. Paul	4,248.0	.....
Chicago, Milwaukee & Puget Sound	1,073.3	.....
Chicago, Rock Island & Pacific	657.5	485.3
Chicago, St. Paul, Minneapolis & Omaha	269.8	443.9
Cincinnati, Hamilton & Dayton	72.0	.....
Cincinnati, Indianapolis & Western	41.8	.....
Colorado Midland	.....	.....
Cornwall & Lebanon	35.7	.....
Cumberland & Pennsylvania	13.3	.....
Cumberland Valley	17.6	.....
Davenport, Rock Island & Northwestern	.....	.....
Delaware & Hudson	.....	.6
Delaware, Lackawanna & Western	.....	.....
Duluth & Iron Range	.....	18.8
Duluth, South Shore & Atlantic	.....	.....
Durham & Southern	56.0	.....
Elgin, Joliet & Eastern	9.2	.....
Erie	421.1	53.7
Chicago & Erie	257.2	.....
Columbus & Erie	32.2	.....
New Jersey & New York	26.1	.....
New York, Susquehanna & Western and Wilkes-Barre & Eastern	.....	.....
Great Northern	174.8	.....
Hocking Valley	74.7	.....
Illinois Central	.....	.....
Kanawha & Michigan	.....	.....
Kansas City, Clinton & Springfield	.....	2.5
Kentucky & Indiana Bridge and Railroad Co.	14.6	.....
Lackawanna & Wyoming Valley	.....	2.4
Lehigh Valley	789.9	.....
Long Island	.....	.....
Louisville & Nashville	265.2	.....
Marquette & Southeastern	3.7	.....
Minneapolis, St. Paul & Sault Ste. Marie	2,165.7	24.4
Missouri, Kansas & Texas	8.6	.....
Missouri Pacific	15.8	14.0
St. Louis, Iron Mountain & Southern	4.6	1.0
Mobile & Ohio	42.4	.....
Mississippi Central	150.0	.....
Nashville, Chattanooga & St. Louis	113.4	.....
Newburgh & South Shore	.....	.....
New York Central Lines:		
Boston & Albany	.....	.....
Chicago, Indiana & Southern	17.4	.....
Cincinnati Northern	206.1	.....
Cleveland, Cincinnati, Chicago & St. Louis	1,016.0	169.8
Lake Erie & Western	880.8	.....
Lake Shore & Michigan Southern	988.3	87.5
Dunkirk, Alleghany Valley & Pittsburg	90.3	.....
Lake Erie, Alliance & Wheeling	.....	87.7
Michigan Central	939.3	.....
New York Central & Hudson River	2,729.7	11.6
Peoria & Eastern	.....	7.0
Pittsburg & Lake Erie	.....	.....
New York, New Haven & Hartford	245.0	.....
Norfolk & Western	1,117.9	550.6
Northern Pacific	845.6	864.7
Northwestern Pacific	199.2	51.3
Cleveland, Akron & Columbus	157.7	.....
Cincinnati & Muskingum Valley	11.4	.....
Pennsylvania	3,058.1	526.6
Grand Rapids & Indiana	.....	4.4
Northern Central	549.1	61.8
Pennsylvania Company	1,043.7	16.1
Philadelphia, Baltimore & Washington	508.0	.....
Pittsburg, Cincinnati, Chicago & St. Louis	1,582.6	16.8
West Jersey & Seashore	.....	113.2
Peoria & Pekin Union	12.0	.....
Pere Marquette	19.0	.....
Philadelphia & Reading	396.1	1.3
Atlantic City	22.6	.....
Northeast Pennsylvania	.....	.....
Perkiomen	38.1	.....
Reading & Columbia	35.7	.....
Queen & Crescent Route:		
Cincinnati, New Orleans & Texas Pacific	.....	.....

*(Atchison, Topeka & Santa Fe Western Lines.) These figures include 22.7 miles of double track road on which the electric train staff is used for trains moving in one direction (down grade), and the simple manual block system, by means of the telephone, for trains moving in the opposite direction.

Richmond, Fredericksburg & Potomac..	174.7	.....
St. Joseph & Grand Island.....	.....	.....
St. Louis & San Francisco.....	8.2	270.5
St. Louis Merchants' Bridge Terminal...	2.2	.....
Seaboard Air Line	.....	206.6
Southern	2,057.2	11.0
Southern Pacific: Pacific System.....	.....	.....
Spokane, Portland & Seattle.....	11.4	.....
Terminal R. R. Assn. of St. Louis.....	.....	.....
Union	.....	.....
Union Pacific	.....	.....
Vandalia	275.9	.....
Virginia & Kentucky	.....	.6
Virginian	2.2	.....
Wabash	1,914.7	.....
Washington Southern	64.3	.....
Western Ry. of Alabama.....	.....	.....
Total	45,857.3	9,859.7

Telephones Used on Montana Excursion

Members of the Butte, Mont., Business Men's Association were given an example of telephone progressiveness by the Montana Independent Telephone Company and the State Telephone and Telegraph Company in the form of local and long distance train telephone service during a recent excursion trip taking in thirty-five cities and towns within a radius of 150 miles of Butte.

At ten of the thirty-five stopping places the big delegation was given exclusive independent telephone service over the lines of the State Telephone and Telegraph and Montana Independent companies, telephones being provided for each of the eleven special cars. Immediately upon the arrival of the special train the local managers of the respective plants would make immediate connection, enabling the excursionists to communicate with their out-of-town customers and friends and with their homes in Butte.

That the innovation was a success was best evidenced by the large number of long distance calls made from the train, as many as 100 being received in Butte from each of the ten points where the service was furnished. President Lane of the Interstate Consolidated, the Montana Independent and other northwestern telephone companies, accompanied the party, incidentally making a tour of inspection over that part of the system. Much valuable publicity obtained as a result of the inauguration of free train telephone service in Montana, a large number of newspapers commenting upon the efficiency of the service and the generosity of the companies of which Mr. Lane is the head.

Postal-Independent Alliance

At a general meeting of forty independent telephone companies of Nebraska held in Lincoln June 1, a tentative contract with the Postal Telegraph Company for exchange of traffic courtesies and mutual use of telegraph and telephone service was unanimously indorsed.

The plan was formulated by F. H. Woods, president of the National Independent Telephone association, in conference with Postal interests.

A committee consisting of W. E. Bell of York, T. H. Pollock of Plattsmouth, C. C. Deering of Omaha, Warren Pratt of Kearney and Frank H. Woods of Lincoln, was appointed to prepare a uniform draft of the contract to be signed by individual companies.

The Postal Telegraph Company offered to connect with the leading independent telephone companies in Nebraska using long distance connections and through them to reach the smaller exchanges which may desire to accept the service.

Big Four Installs Telephones

The Big Four railway is installing telephones on several of its divisions, to a large extent supplanting the telegraph. Wherever tried the experiment has proven satisfactory and the whole system will soon be equipped with long distance instruments to be used in dispatching trains.

Superintendent of Telegraph Rhoades is now devoting much of his time and attention to perfecting the system. The Indianapolis and Michigan City division of the Lake Erie and Western between Indianapolis and Peru is also being fitted out with telephones.

Telephones for Metal Mines

In speaking of electrical and telephone equipment for metal mines R. W. Shoemaker said in a recent paper:

The telephone system for any but a small proposition should be the manual in preference to the automatic, as the telephone operator is a handy person to do small chores, which in the automatic the calling party would have to do himself or leave to his assistant at a greater expense in salary perhaps than an operator would cost. A generous use of telephones always pays. They should be underground at the principal points as well as on the surface. The lines in the shaft should be of No. 14 double-braided, rubber-covered wire fastened to a galvanized iron wire as a messenger and lowered in ¾-in. pipe with the ends sealed with compound. Any other type of construction will give trouble. In the workings the wire should be carried clear of everything on large insulators or else in pipe and the point of changing from conduit to open work should be in a dry place. The telephone instrument itself, for underground work should be mounted in an iron box with a tight-fitting door. By mounting a 16-c. p. lamp inside the box to keep it warm as satisfactory service can be had underground as on top. If the warming lamp is left out moisture will make short contacts in a few weeks, so that on a common battery system, which is preferable to a magneto, the line will show busy.

Usually when a telephone is mounted in a mill the vibration makes conversation almost impossible. Sound-proof booths, so called, are of no avail, but if the transmitter is suspended from a coil spring about four inches long the vibration disturbances will be eliminated. The same construction can be supplied to advantage in the engine rooms or any place subject to powerful vibrations.

If power circuits are adjacent to telephone lines, plenty of protection in the way of fuses should be provided. Where the wires enter the cable, fuses and arrester equipment should be used and again at a distributing rack before entering the switchboard. Each instrument should be protected by arrester and fuse. By using one-half ampere fuses at instruments and cable box, and one-fourth ampere in the distributing rack, and also by having two spark gaps in series to ground at the cable box, light disturbances will blow out only the one-fourth ampere fuses; these are accessible and easily replaced. A heavy discharge or cross wth a power line will open all fuses. On a telephone system constructed as above an accidental cross with a 10,000-volt power circuit did not reach the switchboard or instruments, the fuses and lightning arresters completely protecting the equipment.

The General Assembly at Albany, New York, recently passed a general amendment to the Public Service Commission law, extending the jurisdiction of the commission of the second district to telephone and telegraph companies, while a similar amendment giving jurisdiction to the commission in the first district over telephone companies in New York City was defeated.

Of Interest to the Trade

Telechronometer Considered in Chicago

Officials of the Telechronometer Company, Rochester, N. Y., were in Chicago recently demonstrating that ingenious instrument before the city council. The demonstration was given as a result of a previous showing of the instrument before the Chicago Telephone Company.

Late last fall a demonstration of the machine was given in Rochester, and subsequently it was exhibited in Chicago. Recently the machine has been so far improved that it not only registers accurately the number of calls made from any particular telephone, but as well the aggregate time the telephone has been actually in use, with the result that the telephone service is metered, in effect, precisely as the water or gas or electricity consumed by a particular householder is measured.

Should the instrument be adopted it would mean the establishment of a new basis of telephone charges, the time the telephone is actually in service, rather than a flat rate, being taken as the unit of charge.

In general appearance the instrument is a small box attached to an ordinary telephone instrument. The call is registered against the telephone instrument, whence the call proceeds rather than against the receiving instrument. Nor does it register the call unless the party sought answers, in which case the measurement of time begins only when the second party actually responds.

Those to attend the demonstration in Chicago were F. C. Stevens, president of the company, and Garrison Babcock, of Rochester, chief engineer.

Time by Telephone in Europe

The Hamburg observatory has introduced a convenient system for the automatic distribution of telephonic time signals. A clock at the observatory, controlled by the standing clock, is provided with a simple apparatus by which a signal is sent to the telephone exchange every minute. This signal clearly perceptible as a sound like that emitted by a siren, lasts from the fifty-fifth second to the sixtieth, so that the termination of the sound shows the correct beginning of each minute. Every telephone attached to the exchange can hear this signal when connected, so that no communication with the operator is necessary.

At every fifth minute a different signal is sent to indicate the particular minute and avoid confusion. In this way exact mid-European time is known over a very wide area. No charge is made to those who are on the Hamburg exchange, but those outside the radius pay as for a "trunk call."

The signal is sufficiently loud to be heard whenever the telephone can penetrate, and has been perceived at Copenhagen, Cologne, Wiesbaden, and even Paris. The advantages of having correct time in securing accuracy are obvious, and the scheme is one that should be economically important.

A business man in Norway writes that he is interested in keyless clocks for telephone subscribers, to be installed in offices, residences, etc., and connected with a master clock in the central telephone office. His address may be obtained of the Bureau of Manufacturers, Washington, D. C., File No. 5061, or of TELEPHONE ENGINEER.

Kellogg Contracts

The Kellogg Switchboard and Supply Company announces the closing of two contracts, one being complete new equipment for the Willoughby Telephone Company, Willoughby, Ohio. The switchboard will be a standard 600 line, one section, two-position nonmultiple common battery board, 300 lines equipped. There will be complete new power equipment, relay, rack and distributing frame, mercury arc rectifier, power switchboard and wire chief's desk. The order includes 250 telephones.

The Kellogg Company has been given the work of changing over present equipment of the Austin Telephone Company, Austin, Texas, to the Kellogg harmonic equipment. This includes six position change over on the local board; new key shelves, four-party keys in each cord circuit, three master four-party keys in night toll board and two positions in call toll board. Then will be installed complete four-party ringing equipment, two Kellogg pole changers, one transformer set, the contract including all wire, conduct switches, etc.

Intercommunicating Telephones on the Coast

The Corwin Telephone Manufacturing Company, Chicago, has just received an order for a large intercommunicating system to be installed in the Providence hospital at Seattle, Washington.

The Manny-Myers Company of Seattle, which secured the contract for the entire installation, recently installed a similar system of 18 stations in the residence of Mr. Samuel Hill, vice-president of the Home Company of Portland, Oregon, but who lives at Seattle, and is identified with other independent interests in the west.

The secret service self-operating apparatus put out by the Corwin Company is something entirely new. The same system has also been adapted and is being installed in many banks and other institutions in Chicago by the new company. The apparatus is very simple and reliable, gives absolute secret service between all the stations and works equally well with automatic or manual systems and with any number of trunks or no trunks. One button per station does all the work.

American Electric Fuse Builds New Factory

The American Electric Fuse Company is constructing a new brick factory building which is intended to take care of its fast increasing business in enameled magnet wire and coil windings. The company is a pioneer in the manufacture of enameled wire, and its plant is unexcelled. It has organized a new department to take care of its coil-winding business. C. R. Underhill, formerly of New York, and an authority on magnet windings, has been placed in charge of this work. He has designed and installed a great many new winding machines, has equipped the testing department throughout with new and improved instruments and has quadrupled the out-

put of this branch of the business. The new building is intended to house the two departments, giving them room for expansion and development. It is 150 by 60 feet, and will eventually be carried up to the full height of the company's other buildings in Muskegon, Mich. It will be occupied in August.

Western Electric Pension System

The Western Electric Company was among the first industrial corporations to adopt a system of pensions for superannuated or disabled employes. In March, 1906, the company set aside $400,000 as a permanent fund for this purpose and later $150,000 was added. The fund, with accrued interest, now totals $597,500.

This fund is managed by a board consisting of five officers, employees of the company, appointed annually. Employees who have reached the age of sixty and have been in the company's service twenty consecutive years are eligible to pension, whether able to work or not. Employees who have been thirty years in service or who have reached the age of fifty-five and been twenty-five years in service, may on recommendation of the president be granted a pension allowance. Any employe who has been ten years in service and through injury or sickness has been incapacitated from work, may receive aid from the fund at the discretion of the pension board.

The annual allowance for each employee retired with a pension on account of age or length of service is as follows: For each year of active service one per cent of the average annual pay during the ten years preceding retirement, with the provision that the board may base the pension upon the average annual pay of the ten consecutive years of service during which the retired employee was paid the highest rate of wages. The pension allowance is paid monthly from the date of retirement until death and, at the discretion of the board, the allowances may be continued to widows or orphans for a period not exceeding one year. The expenses of the pension system are borne entirely by the company, the employees contributing nothing to its financial support. At the present time the Western Electric has about 20,000 persons on its payrolls.

Rush Orders for Switchboards

The Kellogg company's reputation for quick delivery of the very highest class work on rush switchboard and telephone orders is well known. Recently two rush orders for switchboards replacing fire losses at Lamar, Missouri, and Bath, Michigan, were completed and delivered on record time.

Quick deliveries by this company, as its customers will appreciate, do not mean carelessly put together apparatus, but the standard built Kellogg exchange.

At the close of the year two more telegraph orders for switchboards replacing boards destroyed by fire were received. One for Dardanelle, Arkansas, for one 300 line, two position magneto switchboard with 200 lines equipped—two operators' sets and 20 cord circuits.

The other from the Hollandale Telephone Company, Hollandale, Wisconsin, for one 100 line magneto switchboard.

Another Mine Telephone Bulletin

The Western Electric Company has just issued its bulletin No. 1110-1, describing telephones and signaling apparatus for mines. It contains two double-page layouts, one a mine plan, the other a wiring diagram for signaling sets and telephones.

The bulletin is profusely illustrated with photographs. It contains cuts of the No. 343-A emergency set for mine use, the No. 1336 type metal mine telephone set and the No. 342 emergency signal bell, together with desk and wall type magneto telephones, and a description of the availability of each of these instruments for varying uses in mines.

The ground plan shows the location of the apparatus for a combined telephone system and emergency signaling system in a mine. This plan has been made expressly to comply with the laws relating to telephones and gongs in the state of Illinois, and it covers a complete protective system for mines. It is followed by a wiring diagram of a combined system of mine telephones and emergency signaling bells.

Johns-Manville Changes Locations

Due to fast increasing business, both the Chicago and Baltimore branches of the H. W. Johns-Manville Company have outgrown their present quarters, and about March 1 both will move to new locations, with more room.

The Chicago branch, now on Randolph street, will move to the four-story and basement building at Nos. 27-29 Michigan avenue, located in the block between South Water and River streets. With 32,500 square feet of floor space, offices, store and stock rooms will all be under one roof, with ample room for all. A full stock of "J-M" products will be carried, thus assuring prompt shipments.

The Baltimore office, store and warehouse will be located at No. 30 Light street. Here the company will have considerably more room than before, and will keep on hand a large stock of "J-M" products and will be in much better position than ever to give all orders prompt attention.

New Preparation for Wood Preserving

Consul-General Frank Dillingham forwards from Coburg, Germany, copy of an article published by the Swedish Chamber of Commerce in London concerning the invention of cresol-calcium by two engineers of the Swedish state railways. The article is claimed to be superior to others for treating railway ties. It is stated that it is to be tested in foreign countries, including the United States—by the Bureau of Forestry.

"Ken-See" Association Formed

A meeting of independent telephone representatives of Tennessee and Kentucky was held at Middlesboro, Ky., June 4, and the "Ken-See Independent Telephone Association" was organized. Numerous improvements will be made to complete long distance circuits in the two states. A copper line will be built at once from Lexington to Livingston to complete the through line from Knoxville to Louisville.

Electric Storage Battery Booklets

The Electric Storage Battery Company has issued two new booklets, namely, "The Story of the Storage Battery" and "How to Light Your Home by Electricity." Both are very interesting to electrical men, and free for the asking.

Brevities of the Business

PERSONAL NOTES.

R. E. Mattison, Lincoln, Neb., well known in the independent telephone field and secretary-treasurer of the Nebraska Independent Telephone System, has resigned that position to accept the general management of the Omaha Independent Telephone Company, succeeding F. E. Ebersole, who is engaged in the construction of a telephone system at Houston, Texas. Mr. Mattison will be succeeded as secretary-treasurer of the Nebraska Independent Telephone System by C. H. Hood, who has been associated with him for some time.

W. C. Polk, a well known telephone engineer of Toledo, Ohio, recently accepted the position of general superintendent and engineer of the Kansas City Home Telephone Company. Mr. Polk had charge of the construction of this plant as well as many others of the most important independent telephone systems in the country.

John C. Conway has been appointed district manager of the western territory of the Chicago Telephone Company with headquarters at Aurora.

W. W. Ryder has been appointed superintendent of telegraph for the Toledo & Ohio Central Railway and the Zanesville & Western Railway with headquarters at the La Salle Street Station, Chicago.

A. T. Hollenbeck has been appointed superintendent of telegraph for the Chicago Great Western Railway, Chicago.

Joseph L. Lillich, formerly connected with the Michigan Home Telephone Company of Detroit in the capacity of chief engineer, recently accepted a position in the commercial engineering department of the New York Telephone Company at Buffalo.

W. S. Fender has accepted the position of assistant superintendent of telegraph of the Southern Pacific Railroad, with headquarters at San Francisco. Mr. Fender will have charge of the telephone equipment.

S. E. Fisher, Detroit, Mich., has accepted the management of the Zenith Telephone Company, Duluth, Minn.

E. D. Winslow has been appointed superintendent of telegraph for the Chicago, Rock Island & Gulf Railway with headquarters at Fort Worth, Tex.

W. J. Hiss, Jr., was recently appointed general manager of the western division of the New York Telephone Company with headquarters at Buffalo. Mr. Hiss has been connected with the New York company in various capacities, having entered its employ in 1895 immediately upon his graduation from Lehigh University. In January, 1909, he became division commercial manager of the company in charge of the Long Island division, which position he held until he assumed the general management of the western division of the company.

W. J. Uhl, Logansport, Ind., was recently chosen secretary and treasurer of the Toll Clearing Company to succeed J. W. Coffey, who was also acting manager of the company, resigned to take up other business. The Toll Clearing Company was organized about two years ago under the direction of the independent telephone companies of the state and has in hand the distribution of the long distance telephone receipts.

Thaddeus S. Lane, until recently managing director of the Montana Independent Telephone Company, has been elected president of the company. Mr. Lane is a well-known and important factor in the western telephone field, now having the presidency of the following companies: Montana Independent Telephone Company, Butte, Mont.; Interstate Consolidated Telephone Company and Home Telephone Company, both of Spokane; Helena Automatic Telephone Company, Helena, Mont.; State Telephone and Telegraph Company, Butte, and the Idaho Independent Telephone Company, Pocatello, Idaho.

C. McCormack has been appointed superintendent of telegraph of the Chicago & Eastern Illinois Railroad, with headquarters at Danville, Ill.

A. F. Rosenberger, formerly general manager of the Homer Roberts Telephone Company, has accepted the position of city sales manager for the Monarch Telephone Manufacturing Company and Time Systems, 839-840 Monadnock building, Chicago.

W. E. Harkness, who for a number of years has been identified with the Western Electric Company in the development of telephone train dispatching, has entered the employ of the United States Electric Company, 284-285 Pearl Street, New York.

Alfred John Greathead, secretary John A. Roebling's Sons Company of Illinois, died at his home, 5605 Calumet Avenue, Chicago, Saturday morning, May 21. Services were held at the residence on Monday; interment at Mount Hope Cemetery. Mr. Greathead was born at Barnstable, England, 1861, and leaves a wife and three daughters. He had been in the employ of the company for twenty-five years.

L. A. Furlong, formerly with McGillis and Gibbs, has been appointed secretary of The Valentine-Clark Company and will assume the duties of his position July 1.

Dugald C. Jackson, professor of electrical engineering at the Massachusetts Institute of Technology and member of the engineering firm of D. C. & M. B. Jackson, has been elected president of the American Institute of Electrical Engineers.

CONVENTIONS.

CONNEAUT LAKE, PA.—The regular session of the Western Pennsylvania Independent Telephone Association will be held at Exposition Park, this city, July 13 and 14.

IN THE MARKET.

WHITESBURG, KY.—The Whitesburg Telephone Company has been purchased by J. L. Comann, an expert telephone man of Norton, Va., and he will begin at once overhauling and repairing the lines. Considerable construction material will be needed. New lines will be constructed to Line Fork and Kings Creek, while a double line will be built from Whitesburg via Eolia and Black Mountain to Stonega, Va., 25 miles. A new switchboard will be added. Bids are asked for on switchboard. Address J. L. Comann, Manager Whitesburg Telephone Company, Whitesburg, Ky.

COLSON, KY.—The Colson Telephone Company has been organized here by James Brown and others for the purpose of building an exchange in Colson, besides lines to Jeremiah and Indian Bottom. Capital stock $500. Construction material will be needed. Address James Brown, Manager Colson Telephone Company, Colson, Ky.

BEREA, KY.—Berea Home Telephone Company, recently organized by F. H. Willis and others, will construct lines over Madison county. One line will be constructed from Berea to Waco, and another from Berea to Richmond, 15 miles. A switchboard will be needed, construction material also. Address Berea Home Telephone Company, Berea, Ky.

MANDRAKE, KY.—J. P. Brown and others here are organizing to construct local independent telephone system in Mandrake. A line will be constructed from Mandrake via Gordon to Banks, 20 miles. Construction material will be needed. Address J. P. Brown, Mandrake, Ky.

HAZARD, KY.—The Perry County Telephone Company has increased its capital stock from $4,500 to $6,000 and will construct long distance lines over Eastern Kentucky. Considerable material will be required. Address D. Y. Combs, Manager Perry County Telephone Company, Hazard, Ky.

EMINENCE, KY.—The Henry County Home Telephone Company has increased its capital stock from $10,000 to $15,000 and announced that it will construct forty miles of new line within the next few months. Material will be needed. Address Henry County Home Telephone Company, Eminence, Ky.

ROSE HILL, VA.—The Lee County Telephone Company has been organized by Levi Honaker, W. R. Whittaker and others. Capital stock $1,500. Will build an exchange in Rose Hill and local independent lines over Lee county. Construction material will be needed. Address W. R. Whittaker, Manager Lee County Telephone Company, Rose Hill, Va.

BURNETTA, KY.—The White Oak Telephone Company has just been organized by H. W. Gardner, Kirk Snowden, J. B. Jasper and others. Capital stock $500. Will build a system in Burnetta with local lines in the country. Material will be needed. Address White Oak Telephone Company, Burnetta, Ky.

BARBOURSVILLE, KY.—The Knox County Telephone Company is securing rights-of-way for the construction of lines to Corbin and London. All the necessary material will be needed. Address Knox County Telephone Company, Barboursville, Ky.

MAYFIELD, KY.—The Clark River Telephone Company increases its capital stock from $3,000 to $6,000 and will make some extensions. One line will be constructed from Mayfield to Hartford, 35 miles, and another from Mayfield to Graves, 20 miles. All the necessary material will be needed. Address Clark River Telephone Company, Mayfield, Ky.

WASIOTO, KY.—The Cumberland Telephone and Telegraph Company has been organized here by B. N. Worthington and others for the purpose of building both local and long distance lines in the Cumberland valley. Capital stock $25,000. Con-

struction material will be needed. Address The Cumberland Telephone and Telegraph Company, Wasioto, Ky.

Colly, Ky.—The Sergent-Ola Telephone Company is in the market for telephones and all kinds of construction material. Elzy Franklin has recently taken over the lines. Address Sergent-Ola Telephone Company, Colly, Ky.

Buncombe, Ky.—R. H. Parsons and others are organizing a local independent telephone company here to build a system in Buncombe. One line will also be constructed to Hindman, 15 miles. Construction material will be needed. Address R. H. Parsons, Buncombe, Ky.

Clay City, Ky.—The Powell County Telephone Company has increased its capital stock from $7,000 to $12,000 and announces some early extensions. A new switchboard will be needed for the Clay City exchange. Material will be needed. Address the Powell County Telephone Company, Clay City, Ky.

Stanton, Ky.—The Red River Telephone Company has been organized here by J. L. Mannring, Oscar Mannring and others. Capital stock $1,000. Will build system in Stanton and construct local independent lines from Stanton to Hazel Green and Caney City. Construction material will be needed. Address J. L. Mannring, Manager the Red River Telephone Company, Stanton, Ky.

Manchester, Ky.—Manchester Local Telephone Company is securing rights-of-way for the construction of a local, independent line from Manchester to Burning Springs, where long distance connections will be made with line to London. Construction material will be needed. Address Manchester Local Telephone Company, Manchester, Ky.

Booneville, Ky.—Middle Fork Telephone Company organized here by A. C. Fenders, Powell Gray and H. R. Munsy, with capital stock of $2,000. Will build a system in Booneville and Owsley county. All the necessary material will be needed. Address the Middle Fork Telephone Company, Booneville, Ky.

Greenup, Ky.—The Greenup Telephone Company increases capital $4,000 to $6,000 and will make some much-needed improvements. Material will be needed. Address Greenup Telephone Company, Greenup, Ky.

Morehead, Ky.—The Rowan County Home Telephone Company will be in the market for a switchboard for its Morehead exchange, besides some construction material for new lines from Morehead to Limestone and Owingsville. It has increased its capital stock from $8,000 to $10,000. Address the Rowan County Home Telephone Company, Morehead, Ky.

Evarts, Ky.—The Black Mountain Telephone Company has been organized here by G. R. Evarts, Wilson Gray and J. L. Day, with a capital stock of $1,000, for the purpose of building a local, independent telephone system in Evarts. One line will also be constructed from Evarts via Black Mountain to Rose Hill, Va., nearest telegraph office. Construction material will be needed. Address G. R. Evarts, Manager the Black Mountain Telephone Company, Evarts, Ky.

Harlan, Ky.—The Harlan Home Telephone Company is securing right-of-way for the construction of a local independent telephone line from Harlan to Poor Fork. Construction material will be needed. Address Harlan Home Telephone Company, Harlan, Ky.

NEW TELEPHONE COMPANIES.

Vandalia, Ill.—The Fayette County Telephone and Telegraph Company has been incorporated with a capital stock of $48,000 by William M. Crouch and C. M. Katterjohn.

Carrier Mills, Ill.—Articles of incorporation have been filed for the Carrier Mills Independent Telephone Company by James C. Cain, Edgar Miller and S. T. Purcell; capital stock $1,500.

Worden, Ill.—The Worden Telephone Company has been incorporated with a capital stock of $2,500 by A. Z. Rice, F. W. Stoecker, S. P. Williamson, C. R. Wall and J. A. Stice.

Abbyville, Kan.—Articles of incorporation have been filed for the P. A. & P. Telephone Company with a capital stock of $10,000. The incorporators are as follows: L. C. Brown, H. C. Churnett, C. S. Gibbens and W. C. Detter of Nickerson, Kan., and F. G. Ray of this city.

Fulton, Kan.—The Mutual Telephone Company has been incorporated; capital stock $25,000. The incorporators are F. S. Mall, Ed. T. Shaffer, F. H. Miles, Alex Mason and D. C. Jenkins.

Munfordville, Ky.—Articles of incorporation have been filed for the Hart County Telephone Company by S. B. Johnson, L. G. Johnson and others; capital stock $500.

Chelsea, Mass.—The William J. Murdock Company has been incorporated to do a general telephone business; capital stock $10,000. William J. Murdock, Everett, is president of the company.

Shoals, Ind.—The Shoals and Dubois Telephone Company has been incorporated with the following officers: President, Peter Fuhrman; vice-president, John F. Braun, Shoals; secretary, Otto E. Waldrip, Dubois; treasurer, Christopher Braun, Shoals; capital stock, $1,000.

Esto, Ky.—B. C. Burt, A. H. Bullard and S. B. Collins are the incorporators of the Russell Spring and Columbia Telephone Company, which has been organized with a capital stock of $1,000.

Burnips Corners, Mich.—The Salem Telephone Company has been organized for the purpose of constructing farmers' lines. The directors of the company are as follows: H. Weber, J. M. Gordon, M. C. Loew, George Heck, C. Raab, W. C. Loew and C. De Jongh.

Manston, Minn.—Articles of incorporation have been filed for the Manston Telephone Company with a capital stock of $5,000. The officers of the company are as follows: President, Paul E. Stoneheart; vice-president, Carl Tanberg; secretary, Louis L. Lamsdalen; treasurer, Edward Danke.

Olivia, Minn.—The Renville County Telephone Company has been incorporated with a capital stock of $100,000. The incorporators of the company are: A. C. Bowe, president and treasurer; W. J. Huff, vice-president and secretary, all of St. Paul.

Harmony, Minn.—The Harmony Telephone Exchange is the name of an organization recently incorporated with a capital stock of $10,000. The officers are as follows: President, O. N. Thundale; secretary, L. O. Haugen; treasurer, Jas. S. Jacobson.

Lone Jack, Mo.—The White Oak Telephone Company has been incorporated with a capital stock of $4,500 and has the following directors: James D. Jackson, Fred L. Perdue, John W. Season, James D. Kreger and Harry C. Cave.

Louriston, Minn.—Articles of incorporation have been filed for the Kerkhoven Louriston Telephone Company with a capital stock of $5,000. The incorporators are as follows: President, J. H. Lewis; vice-president, Wm. Strom; secretary, Fred Armstrong; treasurer, O. G. Hough.

Bozeman, Mont.—The Middle Creek Telephone Company has been incorporated by S. C. Kenyon, J. T. Matthews and C. M. Thorpe, all of Bozeman, who are also directors of the company; capital stock, $2,000.

Havre, Mont.—Articles of incorporation have been filed with Secretary Yoder for the Northern Montana Telephone Company. The incorporators are W. C. Broadwater, J. S. Carnal, W. H. Blair, and D. S. McKenzie, all of Havre. The capital stock of the company is $25,000. It is the purpose of the company to construct many telephone lines in the northern part of the state.

Merriman, Neb.—The Central Telephone Company has been incorporated with a capitalization of $2,000.

Cutris, Neb.—T. R. Elson, Wm. Barackman and Wm. Schick have incorporated the Curtis and Fox Creek Telephone Company with a capital stock of $5,000.

Grant, Neb.—The Grant Telephone Company has been incorporated by E. H. Hill, B. F. Hastings, E. C. Hoffman and F. M. Bell. The capital stock is $4,000.

Andover, N. Y.—A charter has been granted the Andover Telephone Company through its incorporators, C. L. Early, Jesse S. Phillips, Earl A. Richardson, Frank S. Clark, B. S. Brundage, F. W. Burrows, Erwin D. Parker, John E. Cannon and Henry Stephens, all of this city. The capital stock is placed at $5,000.

Newark, N. Y.—The Wayne Telephone Company has been incorporated with principal office in this city. The capital stock is $250,000, and the directors of the company are as follows: Willis P. Rogers and George F. Waters, Williamson; Albert Yeomans, Walworth; J. S. Brandt and P. F. Osborn, Ontario; Henry P. McDonough, Newark, and Frank B. Gaylord, Sodus.

Walden, N. Y.—The Walden Telephone Company has been incorporated by C. F. Fowler and M. I. Fowler with a capital stock of $30,000.

Morris, N. Y.—The Dimock Hollow Telephone Company has been incorporated with a capital stock of $3,000 by B. F. Wells, Orrin Wightman, Allen Backus, E. E. Carpenter, Henry Wallace, Aaron Hammond, Volney J. Hoke, Morris and Andrew Z. Carleton, New Lisbon.

Plattsburg, N. Y.—The Ausable Home Telephone Company has been incorporated by J. M. Wever and L. W. Hayes; capital stock, $30,000.

Dresden, N. D.—Articles of incorporation have been filed for the Dresden Rural Telephone Company by Aug. Moritz, Albert J. Timian, J. G. Mueller, John Schwan and Geo. A. Williams; capital stock, $10,000.

Garrison, N. D.—The Farmers' Rural Telephone Company has filed articles of incorporation with a capitalization of $25,000.

Mylo, N. D.—C. A. Mudge and J. G. Mundy are the in-

corporators of the Mylo Farmers' Telephone Company; capital stock, $5,000.

ROY, N. M.—The Roy Telephone Company was recently incorporated by Ada B. Shutt, Adele Buscheven and Alice M. Taylor with a capital stock of $50,000.

EPPING, N. D.—C. L. Gemberling, J. M. Seaton, and W. D. Potter of Wheelock and Frank Haney and C. V. Loritzon of this place have incorporated the Truax Telephone Company with a capital stock of $25,000.

LANGDON, N. D.—The Langdon Waterloo Telephone Company has been incorporated with a capital stock of $6,000, and the incorporators are J. J. Mahoney, C. W. Toews, C. Spenst, C. Krahn, and A. W. Toews.

LOMA, N. D.—Articles of incorporation have been filed for the Gordon Farmers' Telephone Company by John Watz, Fred Heimbecker, A. J. Lunde and others; capital stock, $7,000.

BAILEYS, N. C.—S. C. Wells and H. B. High have incorporated the Merchants' Telephone Company with a capital stock of $10,000.

MORELAND, OKLA.—M. P. Myers, N. R. Ames, T. H. Whiteneck, A. S. Jenish and F. E. Schilling are the directors of the Mooreland Telephone Company recently incorporated with a capital stock of $12,000.

ERICK, OKLA.—Articles of incorporation have been filed for the Erick Farmers' Telephone Company with a capital stock of $3,000.

LENAPAH, OKLA.—The City Telephone Company has been incorporated with a capital stock of $1,500 by Geo. A. Elrod, A. T. Rogan, J. M. Holmes, C. M. Wakefield of this city and M. W. Brown of Coffeyville.

BURNS, ORE.—The Burns Independent Telephone Company has been incorporated by J. W. Geary, W. D. Baker and Chas. W. Ellis, with a capital stock of $5,000.

MARION, ORE.—Through its incorporators, B. Pearson, Geo. H. Stephens and W. C. Webb, the Marion Telephone Company has been granted a charter by the secretary of state; capital stock, $800.

CLINTON, OKLA.—The Washita Valley Telephone Company has been incorporated with a capital stock of $15,000.

WILLIAMSPORT, PA.—Articles of incorporation have been filed for the West Branch Telephone Company with a capital stock of $10,000.

PLEASANT HILL, PA.—The Pleasant Hill Telephone Company has been organized with a capital stock of $5,000.

TAYLORSTOWN, PA.—Articles of incorporation have been filed for the Farmers' Telephone Company with a capital stock of $5,000. The incorporators are John G. Snodgrass, who is also treasurer of the company, R. W. Wolfe, W. H. Phillips and W. G. Cindall.

YALE, S. D.—The Lakeside Telephone Company has been incorporated by J. M. Pullman, Jacob T. Hofer and Ludwig Holm with a capital stock of $15,000.

LAKESIDE, PA.—The Lakeside Rural Telephone Company has been incorporated by Henry W. Kraus, Wm. C. Seddon and William Sparr and Joseph Handschets, Barnesville; capital stock, $10,000.

MT. PLEASANT, PA.—The Mt. Pleasant Farmers' Telephone Company has been incorporated by J. C. Byers, Nelson Poorbaugh, R. S. Love, C. B. Huff and Isaac Sherrick with a capital stock of $5,000.

KENNARD, PA.—The Kennard Telephone and Telegraph Company has been incorporated with a capital stock of $10,000 by T. C. Canon, J. E. Stevenson, James M. Ray, A. C. Minnis and Oscar Ray.

TREXLERTOWN, PA.—The Trexlertown Telephone Company has been incorporated; capital stock, $5,000. The incorporators are Silas G. Croll, John Y. Schultz, Philip Moatz and Lewis Lichenwalner.

HARRIMAN, TENN.—The Tri-County Telephone and Telegraph Company has been organized with a capital stock of $10,000.

WAUTOMA, WIS.—The Wautoma-Mount Morris Farmers' Telephone Company has been incorporated with a capital stock of $10,000.

ROSBY'S ROCK, W. VA.—The Tri-State Telephone Company has been incorporated with a capital stock of $10,000. The incorporators are R. G. Daham, of this place; R. C. Yoho, Jerry Doty, C. L. Bonar, E. L. Sims, and others of Moundville.

SCOTTSVILLE, VA.—The Scottsville Telephone Company has been incorporated with a capital stock of $10,000. W. S. Dorrier is president of the company.

CENTER, COLO.—The Interurban Telephone Company has been incorporated with a capital stock of $20,000, by John Welty, W. A. Moffsinger and E. J. Culp.

KEESEVILLE, N. Y.—Articles of incorporation have been filed for the Ausable Telephone Company, with a capital stock of $50,000. The officers of the company are as follows: President, M. J. Callahan, Keeseville; vice-president, I. H. Griswold, Elyria, Ohio; secretary, F. H. Gardiner, Plattsburgh; treasurer, R. P. McKee, Ausable Forks; directors, the above officers and Albert Sharron, Hon. J. M. Weaver, L. W. Hayes, B. S. Ramsey, T. E. Bombard, Ausable Forks, and John McAuliff, Clintonville.

FINANCIAL ITEMS.

POLO, ILL.—The Polo Mutual Telephone Company has increased its capital stock from $10,000 to $40,000.

LOWELL, IND.—The capital stock of the Northwestern Telephone Company has been increased from $10,000 to $25,000.

NEW BELLESVILLE, IND.—The Pikes Peak Telephone Company has increased its capital stock from $2,000 to $10,000. It is the purpose of the company to install a new switchboard and make other improvements. W. S. Cook is president of the company.

MAYFIELD, KY.—The charter of the Clarks River Telephone Company has been amended, increasing the capital stock of the company from $3,000 to $6,000 for the purpose of making extensions. J. W. Hill is manager of the company.

RUSSELLVILLE, KY.—The capital stock of the Auburn Home Telephone Company has been increased from $3,000 to $5,000. It is the purpose of the company to make extensions and improvements.

FREMONT, NEB.—The Farmers' Telephone Company of this place has been granted permission by the Railway Commission to increase its capital stock from $20,000 to $25,000 for the purpose of making additions and extensions.

VALENTINE, NEB.—The North Table Telephone Company will increase its capital stock from $1,550 to $3,050.

DILLON, MONT.—The capital stock of the Southern Montana Telephone Company will be increased from $10,000 to $40,000. The company contemplates making many improvements and extensions.

SUTHERLAND, NEB.—The Sutherland Telephone Company has been granted permission to issue stock to the amount of $2,500 for the purpose of extending and improving its system.

EAST HANOVER, PA.—The capital stock of the East Hanover Telephone Company has been increased from $10,000 to $25,000.

HUNTINGTON, PA.—The Huntington & Center County Telephone Company has doubled its capital stock, increasing it from $5,000 to $10,000.

TEMPERANCE HALL, TENN.—The Temperance Hall Telephone Company has amended its charter, increasing its capital stock from $1,000 to $2,500.

WOODVILLE, OHIO.—The capital stock of the Woodville Home Telephone Company has been increased from $10,000 to $25,000.

STANTON, TENN.—The Stanton Telephone Company has amended its charter, increasing its capital stock from $1,000 to $4,000.

LOWVILLE, N. Y.—The Black River Telephone Company contemplates increasing its capital stock from $50,000 to $200,000.

KAUKAUNA, WIS.—At a recent meeting of the stockholders of the Kaukauna Telephone Company it was decided to increase the capital stock from $5,000 to $10,000.

BUTTE, MONT.—The report of the Montana Independent Telephone Company for the fiscal year shows a gross increase over the previous year of $51,010.92, with a net increase of $15,330.50. The company has 6,437 telephones in operation, a gain of 2,349 stations for the year ending June 1st. In addition to its own telephones the company has connections over associated and allied lines with approximately 8,000 telephones. The lines of the company reach the following cities and towns: Bozeman, Belgrade, Manhattan, Salesville, Livingston, Helena, Great Falls, Billings, Big Timber, Red Lodge, Columbus, Roundup, Lewistown, and other points.

FRANCHISES ASKED AND GRANTED.

FITZGERALD, GA.—At a recent meeting of the city council the Bowen Telephone Company was granted a twenty-year franchise to operate a telephone system in this city, the company to pay $200 per year for the first ten years and $300 per year for the second ten years.

CORNING, CAL.—A franchise has been granted Joseph Tait who represents a new telephone company, to be incorporated for the purpose of constructing and maintaining a telephone system.

GOSHEN, IND.—The Union Telephone and Telegraph Company of Indianapolis has petitioned the city council for a franchise for a long distance exchange in this city.

NEWCASTLE, IND.—The Newcastle Telephone Company has been granted a 35-year extension to its franchise, one provision of the ordinance being that in the event the Newcastle Telephone

Company eventually occupies the field exclusively, the city shall receive 1 per cent of the gross earnings. The present franchise of the company will expire in about ten years.

Goshen, Ind.—The Home Telephone Company has asked for a revised franchise in Elkhart, so as to enable it to raise its rates for business houses and buy the Bell exchange.

Bloomfield, Ind.—The board of trustees of Bloomfield have granted a franchise to William Van Meter and John E. McLaughlin to construct another telephone system in Bloomfield.

Des Moines, Iowa.—F. C. Williams, Carroll Wright and G. F. Henry have asked the city council for a franchise authorizing the installation of an automatic telephone system, but the matter will have to be submitted to popular vote.

Bushton, Kan.—The Bushton Telephone Company has been granted a franchise to construct and maintain a telephone system in this place.

Deerwood, Minn.—The Deerwood and Bay Lake Telephone Company has been granted a 20-year franchise to construct and operate a telephone system in this city.

Audubon, Iowa.—The Audubon Telephone Company has been granted a 25-year franchise to construct and maintain a telephone, telegraph and electric timing system in this city.

Vernon, N. Y.—The Utica Home Telephone Company has been granted permission to construct and operate a telephone system in this place.

Garrettsville, Ohio.—S. C. Templin has been granted a franchise to construct and operate a telephone system in this place.

Longbranch, Wash.—The Pierce county commissioners have granted permission to construct telephone lines covering McNeill's Island, Meridian, Longbranch, Lake Bay, Glen Cove and Vaughn. R. B. Sampson of Vaughn is president of the company and S. S. Watkinson, Longbranch, is secretary.

Higgins, Tex.—A franchise has been granted the Home Telephone Company, recently incorporated, to construct and operate a telephone system in this place. A. M. Winsett is president of the company and L. B. Collins secretary and treasurer.

MISCELLANEOUS.

Mammoth Springs, Ark.—The lines of the South Fork Telephone Company, including lines to Hardy, South Fork and Morristown, have been purchased by the Hynson Brothers Telephone Company.

Wilmington, Del.—The telephone system maintained by the Wilmington Light, Power and Telephone Company, has been purchased by the Wilmington Automatic Telephone Company for a consideration of $1,500,000.

Augusta, Ga.—The Georgia Railroad will install telephones for train dispatching, the first installation to be made between Atlanta and Augusta, a distance of 171 miles, and from Camak to Macon, a distance of 74 miles.

Summerville, Ga.—The Southern Bell Telephone Company will soon begin the erection of a new exchange building in this place.

Galesburg, Ill.—The Central Union Telephone Company will make improvements to cost about $350,000, work to commence as soon as possible. The improvements will include a new building, underground service in the fire district and entirely new equipment of instruments for the subscribers.

Elmwood, Ill.—The Elmwood Telephone Company has been purchased by E. M. Maher, Brimfield, Ill., V. W. Clark will have the management of the system.

Decatur, Ill.—Decatur Home Telephone Company has purchased the exchanges at Warrensburg and Latham and the lines along the Illinois Central between this city and Lincoln.

Chicago, Ill.—The Chicago Telephone Company has completed plans for the erection of a sixteen-story building at 191 to 197 Washington street adjacent to its present building at Washington and Franklin streets, to be used largely as an office building. It will cost approximately $1,000,000.

Blairsville, Iowa.—The Vaughn Telephone Company of this place has been purchased by the Ellsworth Mutual Telephone Company of Ellsworth, who will make improvements, including the installation of a new switchboard.

Holy Cross, Iowa.—Plans have been formulated for the organization of the Holy Cross and North Buena Vista Telephone Company. Eugene Slowey is the chief promoter of the enterprise.

Grand Cane, La.—The DeSoto Telephone Company has been purchased by the Home Telephone Company of Shreveport.

Columbus, Ind.—The Indianapolis, Columbus and Southern Traction Company has decided to install telephones between Louisville and Indianapolis for train dispatching purposes.

Wichita, Kas.—The Anderson Electric Company will move its headquarters from McPherson to this city.

Whitesburg, Ky.—The Whitesburg Telephone Company will install an exchange at Eolia, where it will connect with the Harlan Telephone Company. Additional lines will also be built.

Union Parish, La.—The Camie, Cecil and Fay Telephone Company, operating in this place, has been purchased by the Home Telephone Company, of Monroe. The system will be greatly improved.

Jeptha, Ky.—R. M. Davis and F. B. Darwin are planning for the installation of a telephone system in this place and adjoining country.

Osborne, Kas.—At a recent meeting of the Osborne-Cheyenne Telephone Company arrangements were made for extending and improving its system.

Morrison, Ill.—At a recent meeting of the officers and directors of the Farmers' Mutual Telephone Company many improvements were discussed, among them being the construction of a new building for the company and that of placing the wires on the principal streets underground. Charles H. Mason, of Fenton, is president; H. L. Ewing, Lyndon, vice-president; Frank Trautwein, secretary; R. E. Cochran, treasurer. Reports showed the company to be in a prosperous condition.

Rockford, Ill.—The American Bell Telephone Company will erect a new building in this city at a cost of $40,000, which will be the headquarters for the company's business in the middle west.

Girard, Kas.—The Mutual Telephone Company is making arrangements to install a new and larger switchboard, erect a lot of additional cable, and otherwise improve and extend the plant during the present season.

Paducah, Ky.—In pursuance of an order of the United States court the Paducah Home Telephone Company has been sold for $50,000 to T. A. Pedley, acting as agent for the Central Home Security Company. The sale was made by J. D. Powers, special commissioner. S. L. Pake, resident manager, will retain his office.

Owensboro, Ky.—E. H. Cady, of Toledo, has purchased the properties of the Kentucky and Indiana Telephone and Telegraph Company in this county at a receiver's sale for $50,000. The property is valued at $250,000, with a debt of about $175,000.

Livingston, Mont.—The Montana Independent Telephone Company will install an automatic telephone system.

Greenbush, Minn.—The McMahan Independent Telephone Company will rebuild its exchange and install a new switchboard.

Owatonna, Minn.—The Northwestern Telephone Company is planning to expend $96,000 in improvements in this district which is under the charge of A. L. Turner with headquarters at this place.

Duluth, Minn.—At the annual meeting of the People's Telephone Company it was decided to expend $15,000 on improvements during the fiscal year, which will include the installation of new cable lines and other extensions.

St. Paul, Minn.—The Northwestern Telephone Company will spend approximately $400,000 on its St. Paul system during the year.

Boston, Maine.—The Boston & Maine Railroad Company will equip two new divisions of its line with telephones for train dispatching.

Sabine, Neb.—The Saline Telephone Company recently removed its headquarters from this place to Friend, Neb.

Dayton, N. M.—The Dayton telephone system has been purchased by J. Bishop, who will greatly improve and enlarge the same.

Columbus, Ohio.—The offices of the United States Telephone Company have been removed from Cleveland to Columbus and headquarters of the independent long distance company are now located in the Columbus Citizens' building in North Third street.

Dayton, Ohio.—At a meeting of the directors and stockholders of the Home Telephone Company it was decided to make improvements involving an outlay of $250,000. A number of new sub-stations will be installed.

Orbisonia, Pa.—The Orbisonia Telephone Company has purchased the Path Valley Telephone Company operating at Richmond Furnace. The Orbisonia company will rebuild its present system and construct a number of additional lines.

HARRISBURG, PA.—The Cumberland Valley Railroad will equip its lines between this city and Winchester with a complete telephone system for train dispatching.

COLUMBUS, OHIO.—The Ohio House of Representatives recently passed the Elson bill giving telephone companies the right to consolidate, after it had been amended so as to safeguard the interest of the people to a certain extent. Heretofore they have been allowed to consolidate without being subject to any regulations, but under the new law all consolidations shall be subject to the railroad commission.

LOUISE, TEX.—The Louise Telephone Company has been purchased by G. F. Green, who will spend about $4,000 in extending and improving the system.

WAXAHACHIE, TEX.—C. H. Felder has purchased the long distance telephone lines between Fort Worth and this city formerly owned by the Fort Worth Long Distance Telephone Company, for a consideration of $15,000.

ELDORADO, TEX.—The telephone exchange at this place, formerly owned by J. B. Earle, has been purchased by A. P. Bailey of Ozona, Tex., who will make important improvements and extensions.

AUSTIN, TEX.—The Austin City Telephone Company, which has been operated here for the past several years as an independent company, has been absorbed by the United Telephone Company of Austin. The capital stock is $300,000 and it is owned by Northern capitalists. The incorporators are I. B. Cameron and H. M. Daugherty, Columbus, Ohio; James S. Brailey, Toledo, Ohio; and W. D. Hart and G. W. Allen, Austin. The company will install an automatic switchboard.

ABERDEEN, WASH.—The Pacific Telephone and Telegraph Company contemplates the expenditure of $150,000 in enlarging and improving its service to meet the demands of its rapidly growing business, there now being 1,500 prospective patrons waiting for service.

SUPERIOR, WIS.—The Tri-State Telephone Company of Minneapolis has acquired control of the People's Telephone Company and the Zenith Telephone Company.

CHEYENNE, WYO.—The Union Pacific Railway Company is planning to install a telephone dispatching system between Laramie and Sidney, with headquarters in this city.

EL PASO, TEX.—The Tri-State Telephone and Telegraph Company which will take over the franchise of the Southwestern Telephone and Telegraph Company, contemplates the erection of an exchange building.

BISBEE, ARIZ.—The Tri-State Telephone Company, a holding company of the Bell Telephone Company for Texas, New Mexico and Arizona, has taken over the exchanges and lines owned by the Bisbee Improvement Company of this city and the Douglas Improvement Company of Douglas, and will greatly extend and improve the same.

SAN FRANCISCO, CAL.—A club has been formed in this city for the promotion of wireless telegraphy and telephony, with Roy Livingstone, 2323 California avenue, secretary.

DELTA, COLO.—The Colorado Telephone Company has purchased a site at the corner of Fifth and Main streets on which will be erected a new exchange building.

AURORA, ILL.—The Chicago Telephone Company has taken over the lines of the Northern Illinois Telephone company in Kendall county.

VIRGINIA, ILL.—The Cass County Telephone Company of this place has been purchased by E. J. Huff of Jacksonville for $16,000. Mr. Huff will have the management of the plant.

ELGLN, ILL.—A movement is on foot to compel the telephone and telegraph companies to place their wires underground.

KEWANEE, ILL.—The Home Telephone Company will install additional cable to meet the increased demand for service.

AUBURN, IND.—The Home Telephone Company will construct a new exchange and office building and will install the most modern equipment.

WINCHESTER, IND.—At a meeting of the board of directors of the Eastern Indiana Telephone Company of this city, it was decided to entirely rebuild the Parker City plant at a cost of about $5,000.

CHERUBUSCO, IND.—The Cherubusco Telephone Company has been purchased by Henry W. Soest of Fort Wayne for a consideration of $30,000. This system has about 7,000 telephones in operation in Noble and Allen counties, operating exchanges at Huntertown, La Otto, Green Center and Cherubusco.

JEWEL, IOWA.—The plant of the Jewel Telephone Company will be entirely rebuilt and the entire system will be made metallic.

CORNETTSVILLE, KY.—The Cornettsville-Leatherwood Telephone Company, recently organized by A. B. Cornett and others, will install a local telephone system.

ATHOL, KY.—The Breathitt Home Telephone Company, recently organized by Robert B. Gray, Chester M. McPhearson and Daily Hughes, will install a telephone system in this place and will extend lines to Jackson and Elkawtaba.

OVEN FORK, KY.—Henry W. Mullins and others are interested in the installation of a telephone system in this place.

OWENSBORO, KY.—The Kentucky and Indiana Telephone Company, which recently went into bankruptcy, has been reorganized under the name of the Owensboro Telephone and Telegraph Company, with a capital stock of $10,000. Among those interested are Joshua D. Powers and Samuel L. Heller.

FORT DODGE, IOWA.—The Fort Dodge Independent Telephone Company has purchased the Bell interests in this city and will consolidate the two, which gives the Fort Dodge company 3,000. J. M. Plaister, manager of the Independent company since its organization twelve years ago, will continue as manager of the combined companies.

PORTLAND, MAINE.—The Knox Telephone Company will extend a cable across Penobscot Bay at a cost of $28,0000.

PLYMOUTH, MICH.—The Plymouth Telephone Company is making arrangements to rebuild its entire plant in this place in order to meet demands made upon it for additional service.

COLDWATER, MICH.—A business deal of considerable importance to the citizens of this community was the purchase of the Sturgis Telephone Company by the Southern Michigan Telephone Company of Burr Oak.

ST. PAUL, MINN.—The Northwestern Telephone Company will spend a considerable sum in the improvement of its system in this city.

MONROE CITY, MO.—The Farmers' and Merchants' Telephone Company plans extensive improvements, including the installation of 8,000 feet of cable.

OMAHA, NEB.—The Nebraska Telephone Company has purchased the controlling interest in the Douglas County Telephone Company of Valley, Waterlo and Elkhorn. Guy H. Pratt, contract agent of the Bell company, is now president of the company and F. A. May secretary. Extensive improvements will be made in the system.

JUNCTION CITY, KANS.—The Wareham-Dewey Telephone Company contemplates the installation of a common battery system along with other improvements at an estimated cost of $50,000. With this end in view the company is seeking a franchise, which will give them additional privileges and have also asked for permission to increase its rates.

NORWOOD, N. Y.—A certificate has been filed with the secretary of state merging the Norwood Telephone Company with the Adirondack Home Telephone Company.

CLEVELAND, OHIO.—The Cyahoga Telephone Company has awarded a contract to W. T. Paul's Sons for the erection of a new telephone exchange building.

JACKSON, TENN.—The Sun Telephone and Telegraph Company has purchased the holdings of the Stantonville Telephone Company in Tennessee. Terry W. Allen is president of the Sun company.

PENDLETON, TEX.—The telephone exchange at this place has been purchased by Jennings and Son at a consideration of $5,400. It is the intention of the purchasers to put the plant in first class condition.

HOUSTON, TEX.—The Southwestern Telegraph and Telephone Company has purchased a site at a cost of $110,000 on which it will erect a new exchange building.

ABILENE, TEX.—The Roberts Telephone and Electric Company has been sold by the receivers to Lyman C. Klotz of St. Louis; consideration, $43,500.

LONGVIEW, TEX.—J. C. Lacy, president of the Lacy Telephone Company, with exchange at this place, announces that the Carthage plant will be rebuilt in the near future.

MEXIA, TEX.—A majority of the stock of the Mexia Telephone Company has been purchased by W. L. Murphy, vice-president of the First National Bank of Mexia.

BELLINGHAM, WASH.—The Home Telephone Company will construct a toll line connecting Bellingham and Seattle at an estimated cost of $15,000.

KAUKAUKANA, WIS.—The Kaukaukana Telephone Company is making arrangements to construct lines extending into the rural districts in order to meet the demands for service among the farmers.

JANESVILLE, WIS.—The Rock County Telephone Company has taken over the Badger State Telephone Company, and hereafter the company will be known as the Badger Telephone and Telegraph Company. Dr. W. H. Judd is president of the company, Herman Willitz, secretary, and George E. King, treasurer.

MARMADUKE, ARK.—A deal has been consummated whereby

the Independent Rural Telephone Company and the Gainesville Telephone Company have been consolidated and in future the Gainesville system will be operated by the Independent Rural system.

Glendale, Cal.—The Sunset Telephone Company will spend $100,000 in repairing and extending its lines.

Pomona, Cal.—The Pomona Valley Telephone and Telegraph Company has purchased the property of the Home Telephone Company of Chino. Under the new organization J. Albert Dole is president and D. S. Parker secretary and manager. With Pomona as a center the system now covers a large territory.

Toronto, Ont., Can.—The Bell Telephone Company will erect a new telephone exchange at a cost of $40,000.

Pierce, Colo.—The Colorado Telephone Company will expend about $10,000 in establishing a telephone exchange in this place and making other extensions.

Jasper, Fla.—The Jasper Telephone system has been purchased by C. F. Tonn, formerly of Jacksonville, who will conduct the business.

Grangeville, Idaho.—The Pacific States Telephone Company is planning improvements in the local system which will cost about $6,000.

Aledo, Ill.—The People's Telephone Company will build trunk lines between Aledo, Joy and New Boston which will double its equipment for service.

Carthage, Ind.—The Carthage telephone plant has been purchased by the Zike Brothers, of Capose.

Newcastle, Ind.—The Independent Telephone Company, this city, is preparing to spend $65,000 in improving its service.

Valparaiso, Ind.—Sealed proposals will be received by the Northwestern Indiana Telephone Company for the construction of a two-story and basement brick and stone building. Charles F. Lembke is the architect.

Columbus, Ind.—At the annual meeting of the stockholders of the Citizens' Telephone Company of this city it was decided to install a new exchange as soon as possible and all the present telephone instruments in the city and county will be replaced with modern apparatus. The company contemplates the expenditure of $45,000 or more on the new exchange, and it is expected to have the new system in working order within a year. The new system will be of the central energy type. William Fortune, who is president of the New Long Distance Telephone Company, Indianapolis, was elected president of the company; Charles S. Norton, Indianapolis, secretary; John L. Hosea, general manager. The Citizens' company of this city is owned by the New Long Distance Company of Indianapolis.

Augusta, Ill.—The Shiloh Mutual Telephone Company will install an exchange in this place.

St. John, Ind.—The Northwestern Telephone Company is planning extensive improvements and extensions to its system.

Modale, Iowa.—The directors of the Interstate Telephone Company have arranged for improvements to the amount of several thousand dollars at Missouri Valley. A new exchange is to be installed and all wires in the business district are to be placed underground, work to begin within sixty days.

Spirit Lake, Iowa.—The Western Electric Telephone Company has purchased the controlling interest of H. N. Valvorson in the Clear Lake Telephone Company.

Hutchinson, Kan.—The Missouri and Kensas Telephone Company has purchased the B. & B. Telephone Company of this city and the two will be merged and operated as one company. A new and larger exchange will be installed to accommodate the consolidated systems.

Pekin, Kan.—The Pekin Telephone Company has been purchased by a new company, composed of Nathan Hinshaw, Plevna; L. C. Brown and C. S. Gibbens, Nickerson, and George M. Leslie, of this place. Mr. Gibbens, president of the new company, is also secretary of the Nickerson Telephone Company of Nickerson.

Atchison, Kan.—The Atchison, Topeka & Santa Fe Railroad is installing telephone dispatching circuits on all its main lines. When completed the company will have nearly seven thousand miles of telephone lines in use.

Parsons, Kan.—The Home Telephone Company will place its wires underground in the business portion of the city and will also make other improvements and extensions.

Osawatomie, Kan.—T. L. Youman and S. S. Whiteford, owners of the Osawatomie Telephone Company, will install additional cable, both aerial and underground.

Glasgow, Ky.—The Home Telephone Company has purchased the Mutual Telephone Company of Metcalfe county and will operate the system in connection with its own.

Paducah, Ky.—The Paducah Home Telephone Company is organizing telephone companies in the western part of the state for the purpose of constructing lines connecting with the Central Home Telephone and Telegraph Company's long distance lines.

Monroe, La.—The Home Telephone Company will construct a new exchange building.

Sturgis, Mich.—The Sturgis Telephone Company has been purchased by the Southern Michigan Telephone Company, who will improve and extend the system.

Quincy, Mich.—The Independent Telephone Company of this place will completely overhaul its system, installing a new switchboard and placing its lines in cables.

Ludington, Mich.—The United Home Telephone Company will extend its rural and city lines and will construct additional toll lines.

Tioga, N. D.—The Tioga Farmers' Telephone Company will build additional lines, extending its service to the farmers of the surrounding country.

Cooperstown, N. Y.—The Otsego Home Telephone Company was recently purchased by Harry M. McDonough of Utica.

Mt. Zion, Ohio.—The Independent Telephone Company, recently incorporated, has purchased the Mt. Zion Telephone Company, owned by Geo. D. Spitler, for a consideration of $30,000.

St. Joseph, Mo.—The Home Telephone Company contemplates the expenditure of about $300,000 in extending its system during the summer.

St. Joseph, Mo.—The Missouri and Kansas Telephone Compay is planning extensive improvements for its system in this city which will involve an expenditure of $250,000 and will increase the plant's capacity to 20,000 subscribers.

Springfield, Mo.—The Ozark-Bell Telephone Company is preparing the plans and specifications for a new office building for the company, to be erected on South Jefferson street, in case the action now pending in the United States court is decided in favor of the company, said action having been brought about by the consolidation of the Bell and Home Telephone companies in this place and the subsequent raising of rates.

Newark, N. Y.—The Wayne-Monroe Telephone Company and the Wayne Telephone Company have consolidated under the name of the Wayne Telephone Company. The officers are as follows: President, Willis P. Rogers, Williamson; vice-president and general manager, H. P. McDonough, Newark; secretary, C. S. Ormsbee; treasurer, C. P. H. Vary, Newark.

Zanesville, Ohio.—R. H. Evans and Company have been awarded a contract for the erection of a new building for the Central Union Telephone Company on North Sixth street.

Cleveland, Ohio.—A permit has been granted the Cuyahoga Telephone Company for the erection of a new union exchange building at 6517 Broadway.

Klamath Falls, Ore.—The Oregon Independent Telephone Company, recently incorporated with a capital stock of $100,000, has begun the installation of an exchange at Midland. Lines will be extended throughout this portion of the country and an exchange will also be installed at Merrill, where the council has been asked for a franchise, also at Lakeview. The company has applied for a franchise to install another system in this city, which is being opposed by the Midway Telephone Company, the owner of the present system. The Oregon company is said to be backed by Eastern capital.

Falls City, Ore.—A deal has been consummated whereby the property of the Falls City Telephone Company has been taken over by the Dalles Telephone Company, which will make many improvements in the service.

Bartlesville, Okla.—President E. D. Nims of the Pioneer Telephone Company has been canvassing the situation with a view to installing a new telephone exchange in this place.

Philadelphia, Pa.—The Bell Telephone Company of Pennsylvania has issued $18,234,000 additional capital stock for the purpose of taking over the Central District and Printing Telephone Company of Pittsburg and paying off the floating debt of that company, as well as its own. There was issued in exchange for the stock of the Pittsburg concern, $14,402,000 Bell Telephone Company of Pennsylvania stock, and the remainder went to pay for new construction, floating debts, etc.

Pierre, S. D.—The Dakota Central Telephone Company has let a contract to Albert Anderson for the construction of a reinforced concrete telephone and telegraph building, at a cost of $11,000.

Pendleton, Tex.—The local telephone system has been purchased by Jennings & Son, who will put it in first-class condition.

Kittanning, Pa.—The Kittanning Telephone Company is making arrangements to change its system from magneto to common battery, involving an expenditure of about $18,000.